may include sending results of searching the database from a receiver computer to a controller computer over a computer network. Results of searching the database may include any of the information representative of an eyeglass lens order as described above and a barcode associated with the eyeglass lens order.

The method may also include determining a front mold member identity and a back mold member identity from the information representative of the eyeglass lens order, as shown in step 2106. In addition, the method may include sending the determined front mold member identity and the determined back mold member identity to a controller computer. The method may further include sending the determined front mold member identity and the determined back mold member identity to a mold member storage array. A mold member storage array may be configured as described in any of the above embodiments. In addition, the method may include generating a signal to indicate locations of mold members having the determined mold member identities. The method may also include displaying the generated signal to a user. For example, the generated signal may be displayed as a visual and/or audible signal suitable for detection by a user. Furthermore, the method may include generating and/or displaying the signal sequentially to indicate a location of a front mold member and a location of a second mold member. As such, a generated signal may indicate a location of an appropriate mold member to a user. The user may remove the appropriate mold member from the mold member storage array and may assemble an eyeglass lens mold containing a lens forming composition in a mold assembly holder as described above. The lens forming composition may include any of the lens forming compositions as described in above embodiments.

The method may further include scanning a bar code on a job ticket subsequent to placing a mold assembly holder including an assembled eyeglass lens mold in a first curing unit of a lens forming apparatus, as shown in step 2108. Scanning the bar code may include scanning the barcode with a second barcode reader, which may be configured as described in above embodiments. For example, the second barcode reader

may be disposed within a first curing unit proximate to a location at which the mold assembly holder may be placed into the first curing unit by a user. The second barcode reader, however, may also be disposed within the first curing unit proximate to a location at which the mold assembly holder may be removed from the first curing unit or throughout the first curing unit. As such, step 2108 may include scanning a barcode of job ticket on a mold assembly holder containing an assembled eyeglass lens mold prior to, during, or subsequent to curing at least a portion of a lens forming composition disposed within the assembled eyeglass lens mold. In addition, the method may include sending information representative of the barcode to a controller computer over a serial line connection.

As shown in step 2110, the method may include determining parameters of an instrument of the first curing unit from information representative of the barcode. The parameters of the instrument of the first curing unit may define operating conditions for at least partial curing of a lens forming composition. In addition, the method may include altering a parameter of an instrument coupled to a first curing unit in response to the determined parameters. For example, altering a parameter of an instrument may include altering a duration of a light pulse generated by the first curing unit. In this manner, the duration of the light pulse, which may be provided to an assembled eyeglass lens mold by a first curing unit, may vary depending on the eyeglass lens being formed.

Subsequent to treatment in a first curing unit, a user may remove the mold assembly holder and the assembled eyeglass lens mold contained within the mold assembly holder from a conveyor system. Furthermore, the user may place the mold assembly holder into a second curing unit of a lens forming apparatus.

In addition, the method may include scanning a barcode on a job ticket with a third barcode reader subsequent to placing a mold assembly holder in a second curing unit, as shown in step 212. The job ticket may be attached to a mold assembly holder as

described in above embodiments. The second curing unit and a third barcode reader may be configured as described in any of the above embodiments. In addition, the third barcode reader may be disposed within the second curing unit proximate to a location at which the mold assembly holder may be placed into, moved through, or removed from the second curing unit by a user. As such, the method may include scanning a barcode on a job ticket attached to a mold assembly holder containing an at least partially cured lens forming composition prior to, during, or subsequent to curing of a lens forming composition. In addition, the method may include sending information representative of the barcode such as detected light to a controller computer over a serial line connection.

In addition, the method may include determining an eyeglass lens order and/or eyeglass lens information from the information received from the third barcode reader with a controller computer. In addition, the method may include sending the information received from the third barcode reader to a receiver computer over a computer network. The method may include determining an eyeglass lens order and/or eyeglass lens information from the information received from the third barcode reader with a receiver computer. As such, the method may include sending the determined eyeglass lens order and/or the determined eyeglass lens information from the receiver computer to a controller computer.

In addition, the method may include determining a parameter of an instrument coupled to a second curing unit in response to the determined eyeglass lens order and/or the determined eyeglass lens information, as shown in step 2114. For example, the method may include determining parameters of an instrument coupled to a second curing unit, which may define operating conditions for post curing of a lens forming composition. In addition, the method may include altering a parameter of an instrument coupled to a second curing unit in response to the determined eyeglass lens order and/or the determined eyeglass lens information. For example, altering a parameter of an instrument coupled to a second curing unit may include altering a temperature of heat

generated by the second curing unit. As such, the temperature of heat, which may be provided to an at least partially cured lens forming composition, by a second curing unit may vary depending on the eyeglass lens being formed.

A user may disassemble the eyeglass lens mold and may remove the at least partially cured lens forming composition. In addition, the user may place the at least partially cured lens forming composition into the mold assembly holder from which the at least partially cured lens forming composition was removed. The user may also place the at least partially cured lens forming composition disposed within the mold assembly holder into an anneal unit. At least one barcode reader may also be coupled to the anneal unit as described in any of the above embodiments. In addition, at least the one barcode reader may be configured as described in any of the above embodiments. Furthermore, a controller computer may be coupled to at least the one barcode reader coupled to the anneal unit. The controller computer may be configured as described in any of the above embodiments.

The method may also include scanning a mold member as shown in step 2116. The mold member may include a mold member which may have been disassembled by a user subsequent to removing the eyeglass lens mold from the second curing unit as described above. In addition, the method may include scanning a front mold member and a back mold member of a disassembled eyeglass lens mold. For example, a mold member may be scanned with a mold reader.

In an alternative embodiment, the method may also include determining a mold member identity with the mold reader. The method may also include sending information representative of a mold member identity from a mold reader to a controller computer over a serial line connection. In addition, the method may include determining an identity of the front mold member and the back mold member with the controller computer. Alternatively, the method may include sending information representative of a mold

member identity from a controller computer to a receiver computer over a computer network. In this manner, the method may include determining an identity of the front mold member and the back mold member with the receiver computer and sending the determined identities from the receiver computer to a controller computer over a computer network. The method may also include determining an identity of a front mold member and an identity of a back mold member.

In addition, the method may include sending the determined front mold member identity and the determined back mold member identity to a mold member storage array. A controller computer may be coupled to a mold member storage array as described above. A mold member storage array may be configured as described in any of the above embodiments. For example, the mold member storage array may include a plurality of drawers or locations configured to hold a mold member. In addition, the method may include determining an appropriate location for a mold member in a mold member storage array, as shown in step 2118. The method may further include generating a signal to indicate the determined location. In addition, the method may include displaying the generated signal to a user. The signal may be visual and/or audible such that the signal may be detected by a user. The method may also include generating and/or multiple signals sequentially as described in above embodiments. As such, a generated signal may indicate, to a user, an appropriate location for an eyeglass mold member having the determined identity. In this manner, a user may place a mold member into an appropriate location in a mold member storage array until an eyeglass lens order is received which requires use of the mold member.

Fig. 44 shows an embodiment of graphical user interface ("GUI") 2200 which may display eyeglass lens forming-related information on a front panel of controller computer 2002. GUI 2200, as illustrated in Fig. 44, may also be displayed on a front panel of receiver computer 2006. The controller computer and the receiver computer may be configured as described in any of the above embodiments. The controller computer

and/or the receiver computer may include an output device and at least one input device. A variety of input devices may be used. Some input devices include pressure sensitive devices (e.g., buttons or screens), movable data entry devices (e.g., rotatable knobs, a mouse, a trackball, or moving switches), voice data entry devices (e.g., a microphone), light pens, or a computer coupled to the controller computer and/or the receiver computer. The GUI preferably displays controller and/or receiver computer data requests and responses. The output device may be a monitor cathode ray tube, an LCD panel, a plasma display screen, or a touch-sensitive screen.

GUI 2200 may include a main menu and may be displayed by a controller computer or a receiver computer when initially powered. If the main menu is not displayed, a user may access the main menu by clicking a button, which may be labeled Main Menu, on a displayed GUI with a mouse. In response to activating the Main Menu button, the controller and/or receiver computer may cause the main menu screen to be displayed. As depicted in Fig. 44, a GUI may offer a number of initial options on the main menu. The options may include Job Entry 2202, Job Viewer 2204, Alarm Log 2206, Start 2208, Stop 2210, and Exit 2212. Selection of some of the options such as Job Entry 2202, Job Viewer 2204 and Alarm Log 2206 may cause the display screen to change to a different GUI. Selection of other options such as Start 2008 and Stop 2210 may alter an operation of the lens forming apparatus. For example, selecting Start 2208 may cause the lens forming apparatus to begin a process such as curing a lens forming composition. The main menu may also offer other options which allow the user to access machine status information and instrument setup menus such as Maintenance 2214, Machine Setup 2216, and Configuration 2218. Any one of the options may be selected by a user by clicking an appropriate button with a mouse.

GUI 2200 may also display machine status-related information on the main menu. For example, GUI 2200 may include a graphical icon or a display listing properties of a lens forming apparatus in graphic and/or alphanumeric format. A graphical icon or a

display may appear or may be altered on GUI 2200 in response to a change in status of lens forming apparatus 2000. For example, as shown in Fig. 45, icon 2220 representative of a mold assembly holder, as described in above embodiments, may appear on GUI 2200 when a mold assembly holder is placed in a first curing unit or a second curing unit of lens forming apparatus 2000. A position of icon 2220 on the GUI may also indicate a unit within which the mold assembly holder is disposed and a position of the mold assembly holder within the unit. For example, a position of the mold assembly holder within the unit may be determined from a time of initial detection and a speed of the conveyor system. In this manner, the position of icon 2220 on the GUI may correspond to the determined position of the mold assembly holder within the unit.

In addition, an icon may be altered in color to indicate a change in status of a lens forming apparatus. For example, an icon, which may represent a signal tower of a lens forming apparatus, may include series of icons 2222 of different colors. Upon a change in status of the apparatus or in an alarm coupled to the apparatus, a color of one of series of icons 2222 may be altered on GUI 2200. For example, in Fig. 44, a color intensity of two of series of icons 2222 of signal tower may be altered to indicate 1) that an alarm may be present and 2) that the machine may be running. Alternatively, as shown in Fig. 45, a color of only one of series of icons 2222 may be altered to indicate only 2) that the machine may be running. In addition, alphanumeric characters 2224 may appear on GUI 2200 proximate one of the series of icons representing the signal tower to indicate a change in status of the machine corresponding to a change in color of one of the series of icons.

As shown in Fig. 44, upon activation of an alarm, display 2226 of GUI 2200 may display machine-status information in alphanumeric format. Display 2226 of GUI 2200 may include a list of properties to indicate that, for example, "Lower Left Init Filter Not In Place" and "Job Not Found in Database" in addition to any other status-related information. GUI 2200 may also include an option such as Acknowledge 2228 arranged proximate text

block 2226. A user may select Acknowledge 2228 to access and/or remove machine-status information from text block 2226.

Fig. 46 shows an alternate embodiment of graphical user interface ("GUI") 2228 which may display eyeglass lens forming-related information on a front panel of controller computer 2002. GUI 2228, as illustrated in Fig. 46, may also be displayed on a front panel of receiver computer 2006 or on a front panel of client computer system 2008. The controller computer, the receiver computer, and the client computer system may be configured as described in above embodiments. GUI 2228 may display controller and/or receiver computer data requests and responses. GUI 2228 may include a main menu and may be displayed by a controller computer or a receiver computer when initially powered. GUI 2228 may also be displayed by a client computer system upon request from a user.

As depicted in Fig. 46, GUI 2228 may offer a subset of the initial options displayed on GUI 2200. For example, GUI 2228 may be displayed to a user who may have limited access to information and/or control of lens forming apparatus 2200. A user may be required to obtain a user id to access the system. Access granted to a user may vary depending on the user. For example, access granted to a user may be determined from information provided by a user upon request for a user id. For example, an operator or an engineer, who may operate and/or maintain a lens forming apparatus, may be granted more access to information and control of the apparatus than a client. Therefore, the options which may be displayed either on GUI 2200 or GUI 2228 may be determined by a user id provided by a user during a login routine. A login routine may also require a user to enter a password. In this manner, access to the system through either GUI 2200 or GUI 2228 may be controlled and/or monitored to protect the identity of the users, as well as the privacy and integrity of the information. A user may also be required to enter a password upon selecting Exit 2212 from either GUI 2200 or GUI 2228 for privacy and integrity purposes.

For example, upon login by an operator, GUI 2200 may be displayed on a controller computer or on a receiver computer. Upon login by a client, however, GUI 2228 may be displayed on a client computer system to provide a limited number of options such as Job Entry 2202, View Jobs 2204, Configure 2218, and Exit 2212. As described above, any one of the options may be selected by a user by clicking an appropriate button with a mouse. In addition, selection of a similar option from either GUI 2200 or GUI 2228 may cause the display screen to change to substantially the same GUI. Therefore, regardless of whether Job Entry or View Jobs is selected from GUI 2200 or GUI 2228, respectively, the display screen may be changed to a prescription input menu.

Selection of Job Entry 2202 may cause the display screen to change to prescription input GUI 2230, an embodiment of which is shown in Fig. 47. GUI 2230 may be displayed on a controller computer, a receiver computer, and/or a client computer system. The controller computer, the receiver computer, and the client computer system may be configured as described in any of the above embodiments. Prescription input GUI 2230 may preferably allow a user to enter data pertaining to a new lens order. The prescription input menu may include a number of menu items which may be configured to collect information from a user. For example, the prescription input menu may include a number of input windows 2232 which may be configured to receive alphanumeric input from a user. In addition, the system may be configured to generate and display a signal to the user upon an invalid entry in an input window.

In addition, the prescription input menu may include a number of selection menus which may include radio buttons 2234 and/or pull-down menus 2236. A radio button may be an item that may be selected or deselected, and which displays its state to a user. In addition, in a menu of radio buttons, typically only one radio button may be selected at a time. For example, upon selection of one radio button in a menu, each of the other radio buttons in the menu may be shaded to indicate that these selections are unavailable.

Furthermore, additional menu items displayed on a GUI may be altered upon selection of a radio button. For example, if a user selects a radio button to indicate that a new lens order includes a right lens and a left lens, then pull down menus may appear on the GUI to accept prescription information for both the right and the left lens. A pull down menu may include a number of options which may be viewed by selecting the pull down menu. In addition, a user may select one of the number of options from the pull down menu. A selected option may appear in a text box of the pull-down menu subsequent to selection by a user. Additional pull down menus may be altered upon a selection from a pull down menu. For example, upon selection of zero cylindrical power, a pull down menu for a cylinder axis power may be removed from GUI 2230 or may be shaded to indicate that the pull down menu is currently inactive (i.e., the menu may not accept input from a user).

Each of the menu items allows entry of a portion of the lens prescription. The lens prescription information may include, but is not limited to, job number, patient name, mold assembly holder number, priority, bin location, lens location (i.e., left lens or right lens), lens type, monomer type and/or tint, spherical power, cylindrical power, axis, and add power. The monomer selection may include choices for example, either clear or photochromic lenses. The lens type item may allow selection between spheric single vision, aspheric single vision lenses, flattop bifocal lenses, and asymmetrical progressive lenses. The sphere item allows the sphere power of the lens to be entered. The cylinder item allows the cylinder power to be entered. The axis item allows the cylinder axis to be entered. The add item allows the add power for multifocal prescriptions to be added. Since the sphere power, cylinder power, cylinder axis, and add power may differ for each eye, and since the molds and gaskets may be specific for the location of the lens (i.e., right lens or left lens), the GUI preferably allows separate entries for right and left lenses.

A user may cancel a new lens order at any time by selecting an option such as Cancel Entry 2238 which may be displayed on prescription input GUI 2230. In addition,

a user may submit a new lens order by selecting an option such as Create Job 2240 which may also be displayed on prescription input GUI 2230. Upon selection of Create Job 2240, the new lens order submitted by the user may be sent to a receiver computer or a controller computer. In addition, the new lens order may be stored in a database of eyeglass lens orders as described in above embodiments. Furthermore, each entry of the new lens order may be compared to valid entries for an eyeglass lens order. If any of the entries do not match valid entries, GUI 2230 may display an error message to the user. For example, a new lens order submitted by a user may not be filled by a lens forming apparatus if the lens forming apparatus does not include appropriate molds to form the ordered lens. In this manner, GUI 2230 may display an error message to the user such as "Prescription Not Available". In addition, an entry may be determined to be invalid if the entry may have been left blank by a user. An appearance of an invalid entry may be altered on GUI 2230 to indicate the invalid entry to a user. For example, if a mold is not available for the left lens, pull down menus for prescription information for this lens may be highlighted, may be indicated with a graphical icon, or may be indicated by alphanumeric characters. GUI 2230 may also be configured to allow a user to alter the invalid entry and to provide a user with additional options such as Cancel Entry 2238 and Create Job 2240.

After the data relating to the prescription has been added, the controller computer, the receiver computer, or the client computer system may prompt the user to enter a job number to save the prescription type. The job number preferably allows the user to recall a prescription type without having to reenter the prescription data. The job number may also be used by the controller computer to control the curing conditions for the lens. The curing conditions typically vary depending on the type and prescription of the lens. By allowing the controller computer access to the prescription and type of lens being formed, the controller computer may automatically set up the curing conditions without further input from the user.

Selection of Job Viewer or View Jobs 2204 may cause the display screen to change to an embodiment of prescription viewer GUI 2242, an embodiment of which is shown in Fig. 48. GUI 2242 may be displayed on a controller computer, a receiver computer, and/or a client computer system. The controller computer, the receiver computer, and the client computer system may be configured as described in any of the above embodiments. Prescription viewer GUI 2242 may preferably allow a user to select an eyeglass lens order and to view data pertaining to the selected eyeglass lens order. For example, GUI 2242 may include input windows, radio buttons, and/or pull down menus as described in above embodiments to allow a user to enter information which may be associated with an eyeglass lens order. For example, GUI 2242 may include pull down menu 2244. The pull down menu may include a list of job numbers which may be viewed by selecting the pull down menu. In addition, a user may select one of the job numbers from the pull down menu. A selected job number may appear in a text box on of the pull-down menu subsequent to selection by a user. In addition, GUI 2242 may include input window 2246 which may be configured to receive alphanumeric characters representative of an eyeglass lens order. For example, a user may enter a patient's name into an input window on GUI 2242. GUI 2242 may also be configured such that additional information related to an eyeglass lens order may be entered by a user.

The information entered by the user may be used to determine additional information related to the eyeglass lens order. The additional information may be determined by a client computer system, a receiver computer, or a controller computer, all of which may be configured as described in above embodiments. For example, the additional information may be determined by processing the input from the user and searching a database of information stored on the client computer system, the receiver computer, or the controller computer. The additional information may be displayed on GUI 2242 such that a user may view the additional information. In addition, GUI 2242 may include a number of options which may be available to the user. For example, GUI 2242 may include options such as Re-Print 2248 and Close 2250. In this manner, the user

may select to print the information displayed in GUI 2242 or to close GUI 2242 and return to the previous menu displayed on the user's computer.

Selection of Alarm Log 2206 may cause the display screen to change to an embodiment of alarm viewer GUI 2252, an embodiment of which is shown in Fig. 49. GUI 2252 may be displayed on a controller computer and/or a receiver computer. The controller computer and the receiver computer may be configured as described in any of the above embodiments. Alarm viewer GUI 2252 may preferably allow a user to view information related to alarms which may have occurred during operation of a lens curing apparatus. Information related to alarms may be presented in tabular format and may include several columns. For example, as shown in Fig. 49, GUI 2252 may include column 2254 which may include alphanumeric characters representative of a date and a time at which an alarm occurred. In addition, GUI 2252 may include column 2256 which may include alphanumeric characters representative of a description of an alarm. GUI 2252 may also include additional columns which may include additional information related to an alarm such as a classification and a priority of the alarm.

A user may also select one of the alarms displayed in GUI 2252. Selection of one of the displayed alarms may cause the GUI to display additional information related to the alarm or to display additional options related to the alarm and/or operation of the lens forming apparatus. For example, upon selection of a displayed alarm, a user may further select to delete the selected alarm or to restart the lens forming apparatus. GUI 2252 may also include a number of options which may be available to the user. For example, GUI 2252 may include options such as Purge Log 2258 and Close 2260. In this manner, the user may select to delete all of the information displayed in GUI 2252 or to close GUI 2252 and return to the previous menu displayed on the user's computer.

Selection of Maintenance 2214 may cause the display screen to change to an embodiment of maintenance viewer GUI 2262, an embodiment of which is shown in Fig.

50. GUI 2262 may be displayed on a controller computer and/or a receiver computer. The controller computer and the receiver computer may be configured as described in any of the above embodiments. Maintenance viewer GUI 2262 may preferably allow a user to view information related to operational status of a lens curing apparatus. Operational status of a lens curing apparatus may be determined by parameters of a number of instruments coupled to the lens curing apparatus. For example, instruments coupled to the lens curing apparatus may include, but are not limited to, thermocouples, timing devices, light detection devices such as photodiodes, and electrical measurement devices. Therefore, parameters of an instrument may include, for example, output of a thermocouple, a timing device, a light detection device, or an electrical measurement device. In this manner, information related to operational status of lens curing apparatus may include, but may not be limited to, temperatures of a post-cure chamber, time, light intensity, and electrical currents being drawn by lamps coupled to the lens curing apparatus. As such, information which may be displayed on the maintenance viewer may include lamp current draws, current upper and lower limits for the current draw, and lamp life remaining.

Information related to operational status of a lens curing apparatus may be displayed in alphanumeric and graphical format. For example, as shown in Fig. 49, GUI 2262 may include output windows 2264 which may include alphanumeric characters representative of information related to operational status of a lens curing apparatus as described above. In addition, GUI 2252 may include a plurality of digital inputs 2266 which may include alphanumeric characters describing an operational status of a lens curing apparatus and a corresponding graphical icon. For example, alphanumeric characters may be used to describe an operation or a process which may be performed by a lens forming apparatus. A graphical icon corresponding to the alphanumeric characters may indicate if the operation or process is currently being performed by the lens forming apparatus or if the operation or process is being performed satisfactorily. For example, if the air pressure within a lens forming apparatus is within operational limits, a graphical

icon corresponding to alphanumeric characters such as "Air Pressure OK" may appear as a solid shape such as a circle. Alternatively, if the air pressure within a lens forming apparatus is outside of operational limits, a graphical icon corresponding to alphanumeric characters such as "Air Pressure OK" may appear as an outlined shape such as a circle. The graphical icons may also be altered depending if various equipment of the lens forming apparatus is on or off. In an additional example, the maintenance viewer may also include digital inputs which may indicate if a lamp current draw is too high or too low and if an alarm is currently activated for the lamp current draw, thereby indicating lamp failure. As such, the maintenance viewer may provide comprehensive information related to the current operational status and setpoints for equipment of a lens forming apparatus.

GUI 2262 may also include a number of options which may be available to the user. For example, GUI 2262 may include options such as More... 2268 and Close 2270. In this manner, the user may select to view more digital inputs as described above by selecting More... 2268 or to close GUI 2262 and return to the previous menu displayed on the user's computer by selecting Close 2270.

Selection of Machine Setup 2216 may cause the display screen to change to an embodiment of machine setup menu GUI 2272, an embodiment of which is shown in Fig. 51. GUI 2272 may be displayed on a controller computer and/or a receiver computer. The controller computer and the receiver computer may be configured as described in any of the above embodiments. Machine Setup GUI 2272 may preferably allow a user to view information related to setpoints and upper and lower limits for parameters of a number of instruments coupled to the lens curing apparatus. As described above, instruments coupled to the lens curing apparatus may include, but are not limited to, thermocouples, timing devices, light detection devices such as photodiodes, and electrical measurement devices. A thermocouple may be configured to measure a temperature of a curing unit or an anneal unit. For example, a thermocouple may be disposed in an air

intake vent of a curing unit or an anneal unit. Therefore, parameters of an instrument may include, for example, output of a thermocouple, a timing device, a light detection device, and an electrical measurement device. In this manner, information related to setpoints and limits for parameters of a number of instruments coupled to the lens curing apparatus may include, but may not be limited to, a temperature of a cure unit, a temperature of an anneal unit, time, light intensity, and electrical currents being drawn by lamps coupled to the lens curing apparatus. For example, a user may user the machine setup menu to enter a setpoint and upper and lower alarm limits for lamp current draws. A temperature of a curing unit may have upper and lower alarm limits of, for example, approximately 150 °F and approximately 150 °F, respectively. A temperature of an anneal unit may have upper and lower alarm limits of, for example, approximately 200 °F and approximately 250 °F, respectively.

The machine setup menu may include a number of menu items which may be configured to collect information from a user. For example, the machine setup menu may include a number of input windows 2274 which may be configured to receive alphanumeric input from a user. In addition, the system may be configured to generate and display a signal to the user upon an invalid entry in an input window. As such, a user may view and alter setpoints and upper and lower limits for a number of instruments coupled to the lens curing apparatus.

In addition, the machine setup menu may include a number of input boxes 2276 which may selected by the user. Upon selection of an input box, a "check" may appear in the input box to indicate to a user that the input box has been selected. The input boxes may include a number of maintenance operations which may be performed by an operator. In this manner, after performing a maintenance operation such as replacing top initialization lamps, replacing bottom initialization lamps, and/or replacing post-cure lamps, a user may access the machine setup menu and may select an appropriate input box. In addition, the system may be configured to store a date and a time at which an

input box is selected and the maintenance operation corresponding to the selected input box in a memory. The stored information may also be stored in a database such as a maintenance log, which may also be viewed by a user through an appropriate GUI.

GUI 2272 may also include a number of options which may be available to the user. For example, GUI 2272 may include options such as Save Changes 2278 and Cancel Changes 2280. A user may submit changes to setpoints and upper and lower limits by selecting an option such as Save Changes 2278. Upon selection of Save Changes 2278, the changes to the setpoints and upper and lower limits may be sent to a receiver computer or a controller computer. In addition, the changes to the setpoints and upper and lower limits may be stored in a database as described in above embodiments. Furthermore, each change to a setpoint or an upper and lower limit may be compared to valid entries for the setpoint or the upper and lower limit. If any of the entries do not match valid entries, GUI 2272 may display an error message to the user. In this manner, GUI 2272 may display an error message to the user such as "Setpoint Out Of Range". In addition, an appearance of an invalid entry may be altered on GUI 2272 to indicate the invalid entry to a user. For example, if a temperature setpoint for an anneal conveyor is out of range, an appearance of an input window for this information may be altered, may be indicated with a graphical icon, or may be indicated with alphanumeric characters. GUI 2272 may also be configured to allow a user to alter the invalid entry and to provide a user with additional options such as Cancel Changes 2280 and Save Changes 2278. A user may cancel changes to setpoints and upper and lower limits at any time by selecting the Cancel Changes option.

Selection of Configuration or Configure 2218 may cause the display screen to change to an embodiment of configuration setup menu GUI 2282, an embodiment of which is shown in Fig. 52. GUI 2282 may be displayed on a controller computer and/or a receiver computer. The controller computer and the receiver computer may be configured as described in any of the above embodiments. Configuration GUI 2282 may preferably

allow a user to view information related to filepath names of various databases and/or directories of information. For example, the GUI may include various windows which may include filepath names of Recipe DB (database) 2284, Job DB (database) 2286, and Ticket Dir (directory) 2288. Each of the filepath names may be used by a computer system, such as a controller computer or a receiver computer, to find, open, and/or use a database or a directory. The Recipe DB may include a plurality of program instructions which may be computer-executable to implement a method for forming an eyeglass lens. The Job DB may include information related to lens forming processes which may have been performed by a lens forming apparatus. In addition, the Ticket Dir may include information related to job tickets which may have been entered by a plurality of users. In addition, the GUI may include an option such as Browse… 2290, which a user may select to search for additional available files which may be used for each database or directory. For example, a user may browse through a memory medium coupled to a computer to search for an alternate file that may be used as a database or directory. Alternatively, a user may enter a filepath name into an input window.

The GUI may also include additional windows which may include a numeric characters which may define a Ticket Poll Rate 2292, a Ticket Print Scale 2294, and a frequency for archiving jobs. Ticket Poll Rate 2292 may serve to define a frequency at which a system may be checked for new files such as job tickets. Ticket Print Scale 2294 may serve to define a size of a printed job ticket. In this manner, a size of a printed job ticket may be defined as a percentage of a page on which the job ticket may be printed.

As depicted in Fig. 53, GUI 2296 may offer a subset of the initial options displayed on GUI 2282. For example, GUI 2296 may be displayed to a user who may have limited access to information and/or control of lens forming apparatus 2200. As defined above, a user may be required to obtain a user id to access the system. Access granted to a user may vary depending on the user. For example, access granted to a user may be determined from information provided by a user upon request for a user id. For

example, an operator or an engineer, who may operate and/or maintain a lens forming apparatus, may be granted more access to information and control of the apparatus than a client. Therefore, the options which may be displayed either on GUI 2282 or GUI 2296 may be determined by a user id provided by a user during a login routine. For example, upon login by an operator, GUI 2282 may be displayed on a controller computer or on a receiver computer. Upon login by a client, however, GUI 2296 may be displayed on a client computer system to provide a limited number of options such as Job DB (database) 2286, and Ticket Dir (directory) 2288. GUI 2296, however, may also be displayed on a controller computer and/or a receiver computer depending on the user id entered by a user. In addition, GUI 2296 may include an option such as Browse... 2290, which a user may select to search for additional available files.

Antireflective Coatings for Plastic Eyeglass Lenses

For plastic eyeglass lenses, formed from the materials described above, a portion of the light incident upon the lenses may be reflected from the eyeglass lens rather than transmitted through the eyeglass lens. For plastic eyeglass lenses up to about 15% of the incident light may be reflected off the eyeglass lens surfaces. To reduce the reflection of light from a plastic eyeglass lens, a thin film may be applied to the lens. Such films may be referred to as antireflective coating films. Antireflective coatings may reduce the reflectance of light from a surface (i.e., increase light transmittance through the film/substrate interface).

While numerous approaches to reducing the reflective losses for glass materials have been developed, few techniques are available for producing antireflective coatings on plastics. Vapor deposition techniques have been used commercially to form antireflective coatings on plastic materials, however these techniques suffer from a number of drawbacks. Some of the disadvantages of using vapor deposition include

relatively large capital expenditure for deposition equipment, significant space requirements, and relatively long cycle times.

Reactive liquid compositions for forming antireflective coatings on lenses have been previously studied. Many of the previously disclosed solutions require heating of the antireflective film to a high temperature after its application to a substrate. In some instances the temperature to cure such solutions may be greater than about 200 °C. Such temperatures may be suitable for the coating of glass substrates, but are higher than most plastic lens substrates are capable of withstanding.

U.S. Patent Nos. 4,929,278 and 4,966,812 describe a process for depositing antireflective films on a plastic substrate by first synthesizing an ethanol gel in a SiO_2-B_2O_3-Al_2O_3-BaO system followed by reliquifying the gel. This material may be applied to a plastic substrate and thermally dried to form a porous film having a low refractive index. Such films, however, may exhibit poor abrasion resistance and can take weeks to form.

U.S. Patent Nos. 5,580,819 and 5,744,243 disclose a composition for producing coatings and a process for preparing single-layer broad band antireflective coatings on a solid substrate, such as glass, ceramics, metals and organic polymeric materials. The process involves applying an acid-catalyzed sol-gel coating composition and a water soluble metal salt to the surface of a solid substrate and curing the applied coating with an aqueous electrolyte solution for a time sufficient to produce a coating. The two step preparation of the coating composition, however, may be time consuming since the treatment with the aqueous electrolyte may take several days.

The use of ultraviolet light curable liquid compositions for forming antireflective coatings on substrates offers a number of advantages over the deposition techniques described above. In particular, the equipment cost tends to be minimal and the

application techniques tend to minimize alterations to the shape or clarity of the plastic item being coated. Additionally, the liquid compositions of the present invention, may be cured in a time of less than about 10 minutes. Finally, the liquid compositions, of the present invention, may be applied to a variety of visible light transmitting substrates. Such substrates may be composed of glass or plastic. It should be understood that the liquid compositions for forming an antireflective coating described herein may be applied to a number of visible light transmitting substrates including windows and the outer glass surface of television screens and computer monitors. The liquid composition may be used to form an antireflective coating on a lens, preferably on plastic lenses, and more preferably on plastic eyeglass lenses.

In an embodiment, a single layer coating may be formed on a plastic lens by coating the substrate with an ultraviolet light curable liquid composition and curing the composition. While the below described procedures refer to the coating of plastic lenses, it should be understood that the procedures may be adapted to coat any of the above described substrates. The cured composition may form a thin layer (e.g., less than about 500 nm) on the substrate. The cured composition layer may have antireflective properties if the thin layer has an index of refraction that is less than the index of refraction of the substrate. This may be sufficient for many applications where a limited increase in visible light transmission is acceptable. Single layer antireflective coatings, however, may exhibit poor adhesion to the plastic lens. Attempts to increase the adhesion to the plastic lens by altering the composition, may cause the index of refraction of the single layer antireflective coating to increase and reduce the effectiveness of such layers.

Better antireflective properties and adhesion may be achieved by use of multi-layer antireflective coatings. In one embodiment, a two layer stack of coating layers may be used as an anti-reflective coating. A first coating layer may be formed on the surface of a plastic lens. The first coating layer may be formed by dispensing a first composition on the surface of the lens and subsequently curing the first composition. The first coating

layer may be formed from a material that has an index of refraction that is greater than the index of refraction of the plastic lens. A second coating layer may be formed upon the first coating layer. The second coating layer may be formed by dispensing a second composition onto the first coating layer and curing the second composition. The second coating layer may be formed from a material that has an index of refraction that is less than the index of refraction of the first coating layer. Together the first coating layer and the second coating layer form a stack that may act as an antireflective coating. The first and second coating layers, together, may form a stack having a thickness of less than about 500 nm.

In one embodiment, the first coating layer may be formed from a coating composition that includes a metal alkoxide or a mixture of metal alkoxides. Metal alkoxides have the general formula $M(Y)_p$ wherein M is titanium, aluminum, zirconium, boron, tin, indium, antimony, or zinc, Y is a C_1-C_{10} alkoxy or acetylacetonate, and p is an integer equivalent to the valence of M. In some embodiments, M is titanium, aluminum, boron, or zirconium, and Y is C_1-C_5 alkoxy (e.g., methoxy or ethoxy). Examples of metal alkoxides include, but are not limited to aluminum tri-sec-butoxide, titanium (IV) isopropoxide, titanium (IV) butoxide, zirconium (IV) propoxide, titanium allylacetoacetate triisopropoxide, and trimethyl borate. The first coating layer may be formed by using a sol-gel (i.e., solution-gelation) process. Metal alkoxides, when reacted with water or an alcohol, undergo hydrolysis and condensation reactions to form a polymer network. As the polymer network is formed the solvent may be expelled. The polymer network will continue to grow until a gel is formed. Upon heating or the application of ultraviolet light, the metal alkoxide gel densifies to become a hardened coating on the plastic lens.

The hardened first coating layer, when formed from a sol-gel reaction of a metal alkoxide may have an index of refraction that is greater than the plastic lens. For example, most plastic lenses have an index of refraction from about 1.5 to about 1.7. The

first coating layer may have an index of refraction that is greater than 1.7 when formed from a metal alkoxide. The use of metal alkoxides has the advantage of allowing a high index of refraction coating on the surface of the lens. Another advantage attained from the use of metal alkoxides is increased adhesion to the underlying substrate. A general problem for many antireflective coatings is poor adhesion to the underlying substrate. This is particularly true for coatings formed on plastic substrates, although adhesion may also be a problem for glass substrates. The use of metal alkoxides increases the adhesion of the coating material to both plastic and glass substrates. The use of metal alkoxides, therefore, increases the durability of the antireflective coating.

The metal alkoxide may be dissolved or suspended in an organic solvent and subsequently applied to a plastic lens. The coating composition may include a metal alkoxide dissolved or suspended in an organic solvent. The coating composition may include up to about 10% by weight of a metal alkoxide with the remainder of the composition being composed of the organic solvent and other additive compounds described below. In one embodiment, suitable organic solvents are capable of mixing with water and are substantially unreactive toward the metal alkoxide. Examples of such solvents include, but are not limited to ethyl acetate, ethers (e.g., tetrahydrofuran and dioxane), C_1-C_6 alkanol (e.g., methanol, ethanol, 1-propanol, and 2-propanol), alkoxyalcohols (e.g., 2-ethoxyethanol-2-(2-methoxyethoxy) ethanol, 2-methoxyethanol, 2-(2-ethoxymethoxy) ethanol, and 1-methoxy-2-propanol), ketones (e.g., acetone, methyl ethyl ketone, and methyl isobutyl ketones, or mixtures of any of these compounds.

In another embodiment, the first composition may include a silane monomer. Silane monomers have the general structure R_mSiX_{4-m}, where R may be C_1-C_{20} alkyl, C_1-C_{20} haloalkyl, C_2-C_{20} alkenyl, C_2-C_{20} haloalkenyl, phenyl, phenyl(C_1-C_{20})alkyl, C_1-C_{20} alkylphenyl, phenyl (C_2-C_{20})alkenyl, C_2-C_{20} alkenylphenyl, glycidoxy (C_1-C_{20}) alkyl, epoxycyclohexyl(C_1-C_{20})alkyl, morpholino, amino(C_1-C_{20})alkyl, amino(C_2-C_{20})alkenyl, mercapto(C_1-C_{20})alkyl, mercapto(C_2-C_{20})alkenyl, cyano(C_1-C_{20}) alkyl, cyano(C_2-

C_{20})alkenyl, acryloxy, methacryloxy, or halogen. The halo or halogen substituents may be bromo, chloro, or fluoro. Preferably, R^1 is a C_1-C_{10} alkyl, C_1-C_{10} haloalkyl, C_2 -C_{10} alkenyl, phenyl, phenyl(C_1-C_{10})alkyl, C_1-C_{10} alkylphenyl, glycidoxy(C_1-C_{10})alkyl, epoxycyclohexyl(C_1-C_{10})alkyl, morpholino, amino(C_1-C_{10}) alkyl, amino(C_2-C_{10}) alkenyl, mercapto(C_1-C_{10})alkyl, mercapto(C_2-C_{10}) alkenyl, cyano(C_1-C_{10}) alkyl, cyano(C_2-C_{10})alkenyl, or halogen and the halo or halogen is chloro or fluoro. X may be hydrogen, halogen, hydroxy, C_1-C_5 alkoxy, (C_1-C_5)alkoxy(C_1-C_5)alkoxy, C_1-C_4 acyloxy, phenoxy, C_1-C_3 alkylphenoxy, or C_1-C_3 alkoxyphenoxy, said halo or halogen being bromo, chloro or fluoro; m is an integer from 0 to 3. The first coating composition may include up to about 5% by weight of a silane monomer.

Examples of silane monomers include, but are not limited to glycidoxymethyltriethoxysilane, α-glycidoxyethyltrimethoxysilane, α-glycidoxyethyltriethoxysilane, β-glycidoxyethyltrimethoxysilane, β-glycidoxyethyltriethoxysilane, α -glycidoxypropyltrimethoxysilane, α-glycidoxypropyltriethoxysilane, β-glycidoxypropyltrimethoxysilane, β-glycidoxypropyltriethoxysilane, γ-glycidoxypropyltrimethoxysilane, γ-glycidoxypropylmethyldimethoxysilane, γ-glycidoxypropyldimethylethoxysilane, methyltrimethoxysilane, methyltriethoxysilane, methyltrimethoxyethoxysilane, methyltriacetoxysilane, methyltripropoxysilane, methyltributoxysilane, ethyltrimethoxysilane, ethyltriethoxysilane, γ-methacryloxypropyltrimethoxysilane, γ-aminopropyltrimethoxysilane, γ-aminopropyltriethoxysilane, γ-mercaptopropyltrimethoxysilane, chloromethyltrimethoxysilane, chloromethytriethoxysilane, dimethyldiethoxysilane, γ-chloropropylmethyldimethoxysilane, γ-chloropropyl methyldiethoxysilane, tetramethylorthosilicate, tetraethylorthosilicate, hydrolyzates of such silane monomers, and mixtures of such silane monomers and hydrolyzates thereof.

Silane monomers, along with colloidal silica, may form low index of refraction silicon-based coatings. In some instances, silane monomers and colloidal silica may be used to form a single layer low index of refraction coating layer on a lens. The use of silicon monomers and colloidal silica, however, tends to produce silicon-based coatings that have poor adhesion to the underlying substrate. The addition of a metal alkoxide to a composition that also contains a silane monomer or colloidal silica may improve the adhesion of the layer. In another embodiment, the adhesion of a silicon-based coating may be improved by the formation of a multi-layer stack. The stack may include a first coating layer which is formed from a metal alkoxide. A second layer may be formed upon the first layer, the second layer being formed from a silane monomer or colloidal silicon. The metal alkoxide based first layer acts as an adhesion layer that helps keep the stack bound to the underlying lens.

In addition the silane monomers and colloidal silica may be mixed with metal alkoxides to alter the index of refraction of the coating composition. Typically, a mixture of a silane monomer with a metal alkoxide when cured onto a lens, will have a lower index of refraction than a coating formed from a metal alkoxide.

In some embodiments, one or more ethylenically substituted monomers may be added to the first composition. The ethylenically substituted group of monomers include, but are not limited to, C_1-C_{20} alkyl acrylates, C_1-C_{20} alkyl methacrylates, C_2-C_{20} alkenyl acrylates, C_2-C_{20} alkenyl methacrylates, C_5-C_8 cycloalkyl acrylates, C_5-C_8 cycloalkyl methacrylates, phenyl acrylates, phenyl methacrylates, phenyl(C_1-C_9)alkyl acrylates, phenyl(C_1-C_9)alkyl methacrylates, substituted phenyl (C_1-C_9)alkyl acrylates, substituted phenyl(C_1-C_9)alkyl methacrylates, phenoxy(C_1-C_9)alkyl acrylates, phenoxy(C_1-C_9)alkyl methacrylates, substituted phenoxy(C_1-C_9)alkyl acrylates, substituted phenoxy(C_1-C_9)alkyl methacrylates, C_1-C_4 alkoxy(C_2-C_4)alkyl acrylates, C_1-C_4 alkoxy (C_2-C_4)alkyl methacrylates, C_1-C_4 alkoxy(C_1-C_4)alkoxy(C_2-C_4)alkyl acrylates, C_1-C_4 alkoxy(C_1-C_4)alkoxy(C_2-C_4)alkyl methacrylates, C_2-C_4 oxiranyl acrylates, C_2-C_4 oxiranyl

methacrylates, copolymerizable di-, tri- or tetra- acrylate monomers, copolymerizable di-, tri-, or tetra- methacrylate monomers. The first composition may include up to about 5% by weight of an ethylenically substituted monomer.

Examples of such monomers include methyl methacrylate, ethyl methacrylate, propyl methacrylate, isopropyl methacrylate, butyl methacrylate, isobutyl methacrylate, hexyl methacrylate, 2-ethylhexyl methacrylate, nonyl methacrylate, lauryl methacrylate, stearyl methacrylate, isodecyl methacrylate, ethyl acrylate, methyl acrylate, propyl acrylate, isopropyl acrylate, butyl acrylate, isobutyl acrylate, hexyl acrylate, 2-ethylhexyl acrylate, nonyl acrylate, lauryl acrylate, stearyl acrylate, isodecyl acrylate, ethylene methacrylate, propylene methacrylate, isopropylene methacrylate, butane methacrylate, isobutylene methacrylate, hexene methacrylate, 2-ethylhexene methacrylate, nonene methacrylate, isodecene methacrylate, ethylene acrylate, propylene acrylate, isopropylene, hexene acrylate, 2-ethylhexene acrylate, nonene acrylate, isodecene acrylate, cyclopentyl methacrylate, 4-methyl cyclohexyl acrylate, benzyl methacrylate, o-bromobenzyl methacrylate, phenyl methacrylate, nonylphenyl methacrylate, benzyl acrylate, o-bromobenzyl phenyl acrylate, nonylphenyl acrylate, phenethyl methacrylate, phenoxy methacrylate, phenylpropyl methacrylate, nonylphenylethyl methacrylate, phenethyl acrylate, phenoxy acrylate, phenylpropyl acrylate, nonylphenylethyl acrylate, 2-ethoxyethoxymethyl acrylate, ethoxyethoxyethyl methacrylate, 2-ethoxyethoxymethyl acrylate, ethoxyethoxyethyl acrylate, glycidyl methacrylate, glycidyl acrylate, 2,3-epoxybutyl methacrylate, 2,3-epoxybutyl acrylate, 3,4-epoxybutyl acrylate, 3,4-epoxybutyl methacrylate, 2,3-epoxypropyl methacrylate, 2,3-epoxypropyl acrylate 2-methoxyethyl methacrylate, 2-ethoxyethyl methacrylate, 2-butoxyethyl methacrylate, 2-methoxyethyl acrylate, 2-ethoxyethyl acrylate, 2-butoxyethyl acrylate, tetrahydrofurfuryl acrylate, tetrahydrofurfuryl methacrylate, ethoxylated bisphenol-A-dimethacrylate, ethylene glycol diacrylate, 1,2-propane diol diacrylate, 1,3-propane diol diacrylate, 1,2-propane diol dimethacrylate, 1,3-propane diol dimethacrylate, 1,4-butane diol diacrylate, 1,3-butane diol dimethacrylate, 1,4-butane diol dimethacrylate, 1,5 pentane diol

diacrylate, 2,5-dimethyl-1,6-hexane diol dimethacrylate, diethylene glycol diacrylate, diethylene glycol dimethacrylate, trimethylolpropane trimethacrylate, tetraethylene glycol diacrylate, tetraethylene glycol dimethacrylate, dipropylene glycol dimethacrylate, trimethylolpropane triacrylate, glycerol triacrylate, glycerol trimethacrylate, pentaerythritol triacrylate, pentaerythritol dimethacrylate, pentaerythritol tetracrylate, pentaerythritol tetramethacrylate.

The first composition may also include amines. Examples of amines suitable for incorporation into an antireflective coating composition include tertiary amines and acrylated amines. The presence of an amine tends to stabilize the antireflective coating composition. The antireflective coating composition may be prepared and stored prior to using. In some embodiments, the antireflective coating composition may slowly gel due to the interaction of the various components in the composition. The addition of amines tends to slow down the rate of gelation without significantly affecting the antireflective properties of subsequently formed coatings. The first composition may include up to about 5% by weight of amines.

The first composition may also include colloidal silica. Colloidal silica is a suspension of silica particles in a solvent. The silica particles may have a particle size of about 1 nanometer to about 100 nanometers in diameter. Amorphous silica particles may be dispersed in water, a polar solvent, or combinations of water and a polar solvent. Some polar solvents that may be used include, but are not limited to methanol, ethanol, isopropanol, butanol, ethylene glycol, and mixtures of these solvents. One example of colloidal silica is commercially available from Nissan Chemical Houston Corp., Houston, TX, and sold under the trade name Snowtex. The first composition may include up to about 5% by weight of colloidal silica.

The first composition may also include a photoinitiator and/or a co-initiator. Examples of photoinitiators and co-initiators have been previously described. Up to

about 1% by weight of the first coating composition may include a photoinitiator or a combination of a photoinitiator and a co-initiator.

The first composition may also include a fluorinated ethylenically substituted monomer. Fluorinated ethylenically substituted monomers have the general structure:

$$CH_2=CR^1CO\text{-}O\text{-}(CH_2)_p\text{-}C_nF_{2n+1}$$

Where R^1 is H or $-CH_3$; p is 1 or 2; and n is an integer from 1 to 40. Examples of fluorinated ethylenically substituted monomer include, but are not limited to, trihydroperfluoroheptyl acrylate and trihydroperfluoroheptyl acrylate. The addition of a fluorinated ethylenically substituted monomer to a composition to be applied to a plastic lens may increase the hydrophobicity of the coating. Hydrophobicity refers to the ability of a substrate to repel water. The addition of a fluorinated ethylenically substituted monomer to the composition may increase the ability of the coated substrate to resist degradation due to exposure to water.

The first composition may be applied to one or both surfaces of a plastic lens. The antireflective coating composition may be applied using a coating unit such as the one described previously. The antireflective coating composition may be applied to the eyeglass lens as the lens is rotated within the coating unit. The plastic lens may be rotated at speeds up to about 2000 rpm as the first composition is added to the plastic lens. Less than 1 mL of the antireflective coating composition may be applied to the eyeglass lens. More than 1 ml may also be applied, however, this amount may be excessive and much of the antireflective coating composition may be flung from the surface of the lens.

The thickness of the applied antireflective coating composition may also depend on the speed of rotation of the eyeglass lens, the viscosity of the antireflective coating composition, the amount of composition added to the eyeglass lens, and the volatility of

the solvent used to dissolve the components of the composition. As an antireflective coating composition is added to a rotating eyeglass lens, the antireflective coating is spread evenly across the surface of the eyeglass lens. The solvent used to dissolve the components of the antireflective coating composition may evaporate as the composition is applied to the eyeglass lens surface, leaving a thin film of the antireflective coating components. As additional antireflective coating material is added, the thickness of the antireflective coating layer will gradually be increased. The rate at which the thickness increases is related to the speed of rotation of the eyeglass lens, the viscosity of the antireflective coating composition, and the volatility of the solvent used to form the composition.

When the composition is applied to a surface of the lens by a human operator, the thickness of the first coating composition may vary due to the operators inability to consistently add the composition to the lens at the same rate each time. To overcome this variability, the composition may be added to the plastic lens with an automated dispensing system. The automated dispensing system may include a syringe for holding the composition and a controller drive system for automatically moving the plunger of the syringe. Such systems are commercially available as syringe pumps. A syringe pump may be coupled to a syringe that includes the composition to be added to the lens. The syringe pump may be configured to dispense the composition at a preselected rate. In this manner the rate at which the composition is added to the surface may be accurately controlled. In another embodiment, the dispenser system may include a conveyor for drawing the syringe and syringe pump across the surface of the lens. As the composition is dispensed by the syringe, the conveyor system may draw the syringe across the surface of the lens. In this manner the rate of application and the distribution path of the composition may be performed in a consistent manner

Assuming a constant speed of rotation of the eyeglass and a constant dispensing rate, as the viscosity of the antireflective coating composition is increased, the rate at

which the thickness of the applied antireflective coating composition increases may increase. Alternatively, the rate at which the thickness of the antireflective coating composition increases may be altered by adjusting the rotation speed of the eyeglass lens. Assuming a constant viscosity of the antireflective coating composition, as the rotational speed of the eyeglass lens is increased, less of the antireflective coating composition will remain on the eyeglass lens as the composition is applied. By slowing down the rotational speed of the eyeglass lens, the thickness of the antireflective coating layer may be increased.

Alternatively, the viscosity of the first composition may be changed by altering the amount of metal alkoxide and other components present in the first composition. For example, a first composition that includes a metal alkoxide at a concentration of about 5% by weight, will have a greater viscosity than a composition that has a metal alkoxide concentration of about 2.5%. The more viscous composition will leave a thicker film on the surface of the lens than the less viscous composition. When the composition is cured a thicker first coating layer may be obtained. The viscosity may also be altered by changing the organic solvent that the metal alkoxide is dissolved or suspended in. Each solvent may have an inherent viscosity that may effect the overall viscosity of the first composition. By changing the solvent this inherent viscosity may be altered, thus altering the viscosity of the overall composition.

As an antireflective coating composition is added to a rotating eyeglass lens, the antireflective coating is spread evenly across the surface of the eyeglass lens. If a solvent used to dissolve the components of the antireflective coating composition has a relatively low boiling point (e.g., below about 80 °C) the solvent will evaporate and allow the more viscous components of the antireflective coating composition (e.g., the silane, organic monomers, metal alkoxide, etc.) to form a coating on the lens. As more composition is added to the eyeglass lens, the thickness of the antireflective coating may increase. By changing solvent used in the antireflective coating composition to a more volatile solvent,

the rate at which the thickness of the antireflective coating grows may increase. Generally, a low boiling point solvent will give a thicker coating layer than a higher boiling point solvent.

In general, the ability to control the thickness of the applied first composition may be important for achieving antireflective properties. In some embodiments, a low viscosity and/or low concentration composition may be used to form the first coating layer. Such compositions may form relatively thin films on the surface of the plastic lens. In some embodiments, the thickness of the formed film may be too thin for the desired application. In an alternate procedure, the first coating layer may be formed by repeatedly applying the first composition to the plastic lens and curing the deposited composition. Each iteration of this process will create a thicker first coating layer. When the first coating layer reaches a preselected thickness the procedure may be stopped and the second coating layer may be formed.

After applying the first composition to the plastic lens, the first composition may be cured to form the first coating layer. Curing of the first composition may be accomplished by a variety of methods. In one embodiment, the first composition may cured by spinning the lens until the composition forms a gel. Alternatively, the composition may be allowed to sit at room temperature for a time sufficient to allow the composition to gel. The gelled composition has a higher index of refraction than the underlying plastic lens, and may therefore serve as the first coating layer. Additionally, at least a portion of the gelled composition may be sufficiently adhered to the plastic lens such that a portion of the gelled composition may remain on the lens during the application of the second composition, thus providing antireflective properties to the lens subsequent to formation of the second coating layer.

Alternatively, the first composition may be cured by the application of heat to the composition. After the first composition is deposited on the lens and spin dried, the first

composition may be in a gelled state. The gelled composition may be heated for a period of about 1-10 minutes at a temperature in the range from about 40 °C to about 120 °C, preferably about 100 °C. Heating of the gelled composition in this matter may cause the composition to be converted from a gelled state to a hardened state. The heat cured first coating layer may exhibit good adhesion to the underlying lens. In some cases, however, the flow characteristics of the second composition when applied to a heat cured first composition may exhibit a non-uniform distribution across the surface of the cured first composition. Furthermore, the first coating layer may have an index of refraction that is greater than the index of refraction of the plastic lens.

In another embodiment, the first composition may be cured by the application of ultraviolet light. As described above, the first composition is applied to the lens and dried to form a gelled composition. The gelled composition may be treated with ultraviolet light for a time sufficient to convert the gelled composition to a hardened state. In some embodiments, the gelled composition is treated with ultraviolet light for a time of about 60 seconds or less. In one embodiment, the ultraviolet light source may be a germicidal lamp, as described above in the spin coating unit (See Figs. 2 and 3). It should be noted that germicidal lamps produce no significant heat energy. Thus, it is believed that the accelerated curing of the first composition is due to the presence of the ultraviolet light, rather than from any heat produced by the lamps. Advantageously, it has been found that the use of ultraviolet light to cure the first composition may provide a surface that allows a uniform distribution of a subsequently applied composition. In comparison, the use of heating to cure the first composition may provide a surface that causes a subsequently applied composition to be unevenly dispersed. Thus the use of ultraviolet light may offer an advantage over heat curing with regard to forming multilayer antireflective coatings.

It is believed that the ultraviolet light accelerates the condensation reaction of the metal alkoxide. The ultraviolet light may interact with the metal alkoxide and excite the electrons of the metal alkoxide, which in turn may accelerate the polymerization of the

metal alkoxide. It is believed that most metal alkoxides have a strong absorbance in the ultraviolet region, specifically at wavelengths below about 300 nm. For example, titanium isopropoxide has a maximum absorbance at 254 nm. In some embodiments, the application of ultraviolet light to the metal alkoxide may be directed toward the coated surface rather than through the substrate. Many visible light transmitting media e.g., borosilicate glasses and plastics, may not allow sufficient amounts of light to pass through to the coating composition at the appropriate wavelength.

After the first coating layer has been applied and cured, a second coating layer may be formed upon the first coating layer. The second coating layer may be formed by applying a second composition to the exposed surface of the first coating layer. In some embodiments, the second coating layer, after curing, is composed of a material that has an index of refraction that is substantially less than the first coating layer.

The second composition, in an embodiment, may be composed of an initiator and an ethylenically substituted monomer. The ethylenically substituted monomers that may be used have been described previously. The initiator may be a photoinitiator, such as was described earlier. Alternatively, the initiator may be a metal alkoxide. It is believed that both photoinitiators and metal alkoxides interact with ultraviolet light and this interaction causes the initiation of polymerization of the ethylenically substituted monomer. The second composition may be applied to the first coating layer in a manner similar to those described earlier. The second composition may include other monomers such as silane monomers, colloidal silica, coinitiators, and fluorinated ethylenically substituted monomer.

The combination of a second low index of refraction coating layer formed upon a first high index of refraction coating material may provide improved light transmission through the underlying substrate. The use of metal alkoxides in one or both layers tends to improve the adhesion of the coating material to the underlying substrate.

Antireflective coatings are thin films that are formed upon the surface of the eyeglass lens. Such films have an optical thickness that is herein defined as the index of refraction of the film times the mechanical thickness of the film. The most effective films typically have an optical thickness that is a fraction of a wavelength of incident light. Typically the optical thickness is one-quarter to one-half the wavelength. Thus for visible light (having a wavelengths approximately between 400 nm and 700 nm) an ideal antireflective coating layer should have a thickness between about 100 and 200 nm. Thicknesses that are less than 100 nm or greater than 200 nm may also be used, although such thickness may not provide an optimal transmittance. In the embodiments cited herein, the combined optical thickness of the coating material may be up to about 1000 nm, more particularly up to about 500 nm.

The ideal thickness of an antireflective coating should be about one-quarter the wavelength of the incident light. For light entering the film at normal incidence, the wave reflected from the second surface of the film will be exactly one-half wavelength out of phase with the light reflected from the first surface, resulting in destructive interference. If the amount of light reflected from each surface is the same, a complete cancellation will occur and no light will be reflected. This is the basis of the "quarter-wave" low-reflectance coatings which are used to increase transmission of optical components. Such coatings also tend to eliminate ghost images as well as the stray reflected light.

Because visible light includes a range of wavelengths from about 400 nm to about 700nm, a quarter-wave coating will only be optimized for one wavelength of light. For the other wavelengths of light the antireflective coating may be either too thick or too thin. Thus, more of the light having these wavelengths may be reflected. For example, an antireflective coating that is designed for interior lights (e.g., yellow light) will have a minimum reflectance for yellow light, while the reflectance for blue or red light will be significantly higher. This is believed to be the cause of the characteristic purple color of

single layer low-reflectance coatings for many camera and video lenses. In one embodiment, the thickness of the antireflective coating layers of an eyeglass lens may be varied or the indices of refraction may be altered to produce lenses which have different visible light reflective characteristics. Both of these variations will alter the optical thickness of the coating layers and change the optimal effective wavelength of light that is transmitted. As the optical thickness of the coating layers is altered the reflected color of the lens will also be altered. In an iterative manner, the optimal reflected color of the eyeglass lens may be controlled by the manufacturer.

While two layer antireflective coatings have been described, it should be understood that multi-layer systems that include more than two layers may also be used. In a two-layer system, a substrate is coated with a high index of refraction layer. The high index of refraction layer is then coated with a low index of refraction layer. In an embodiment, a third high index of refraction (e.g., at least higher than the underlying second coating layer) may be formed on the second coating layer. A fourth low index of refraction layer (e.g., at least lower than the index of refraction of the third coating layer) may also be formed. The four layer stack may exhibit antireflective properties. The four layer stack may have an optical thickness of less than about 1000 nm, and more particularly less than about 500 nm. Additional layers may be formed upon the stack in a similar manner with the layers alternating between high and low index of refraction materials.

In another embodiment, the second coating layer may be formed as a combination of two chemically distinct compositions. The second coating layer may be formed by forming a silicon layer upon the first coating layer. The silicon layer may be formed from colloidal silica or a silane monomer. The silicon layer is applied to the first coating layer and at least partially cured. The silicon layer may be cured by drying, heating, or the application of ultraviolet light.

To complete formation of the second coating layer, a second composition is deposited onto the silicon layer. The second composition may include an ethylenically substituted monomer and an initiator. The ethylenically substituted monomers that may be used have been described previously. The initiator may be a photoinitiator, such as was described earlier. Alternatively, the initiator may be a metal alkoxide. The second composition may be applied to the silicon layer in a manner similar to those described earlier. The second composition may include other monomers such as silane monomers, colloidal silica, coinitiators, and fluorinated ethylenically substituted monomers. The second composition may be cured by the application of ultraviolet light.

The silicon layer, when partially cured or fully cured, tends to exhibit a porous structure. It is believed that the addition of the second composition to a substantially porous silicon layer may allow better chemical interaction between the second composition and the silicon layer. In general, good antireflective properties are seen when a silicon layer is placed upon a first coating layer, when the first coating layer includes a metal alkoxide. The silicon layer, however, may exhibit poor adhesion to a metal alkoxide containing underlying layer. The adhesion of the silicon layer may be improved by the addition of a metal alkoxide to the composition used to form the silicon layer. Silicon containing compositions, such as compositions that include colloidal silica or silane monomers, tend to be unstable in the presence of a metal alkoxide. Generally, it was observed that the mixture of silicon containing compounds with metal alkoxides produces a cloudy composition, and in some cases gelation, prior to the application of the composition to the first coating layer. Such gelation tends to increase the haze observed in the coated lens. The reactivity of metal alkoxides with silicon containing compositions tends to reduce the shelf life of such compositions, making it difficult to store the composition for extended periods of time.

By separating the metal alkoxide from the silicon containing compositions and applying the compositions in a sequential manner, many of the above-described problems

may be reduced. It is believed that the addition of a metal alkoxide containing composition to an at least partially cured silicon layer, causes the second composition to interact with the underlying silicon composition such that a composite layer is formed. This composite layer may exhibit properties that are similar to the properties found for single layers formed from compositions that include silicon compounds and metal alkoxides. Since the silicon containing composition and metal alkoxide containing compounds are applied at different times, the compositions may be stored separately, effectively overcoming the shelf life problems.

In one embodiment, a hardcoat composition may be applied to the plastic lens prior to the application of the antireflective coating stack. Curing of the hardcoat composition may create a protective layer on the outer surface of the plastic lens. Typically, hardcoat compositions are formed from acrylate polymers that, when cured, may be resistant to abrasive forces and also may provide additional adhesion for the antireflective coating material to the plastic lens.

In another embodiment, a hydrophobic coating may be placed onto the antireflective coating. Hydrophobic coatings may include fluorinated ethylenically substituted monomers. Curing of the hydrophobic coating may create a water protective layer on the outer surface of the antireflective coating. The hydrophobic layer may help prevent degradation of the lens due to the interaction of atmospheric water with the lens.

In the above described procedures, the antireflective coating may be formed onto a preformed lens. Such a method may be referred to as an out-of-mold process. An alternative to this out-of-mold process is an in-mold process for forming antireflective coatings. The "in-mold" process involves forming an antireflective coating over an eyeglass lens by placing a liquid lens forming composition in a coated mold and subsequently curing the lens forming composition. The in-mold method is advantageous to "out-of-mold" methods since the in-mold method exhibits less occurrences of coating

defects manifested as irregularities on the anterior surface of the coating. Using the in-mold method produces an antireflective coating that replicates the topography and smoothness of the mold casting face.

The application of an antireflective coating to a plastic lens requires that the first and second coating layers (or more if a multi layer stack is used) be formed onto the mold. In particular, the second coating layer is placed onto the mold prior to forming the first coating layer. In this manner the stack is built backwards. The top of the stack on the casting surface of the mold may be the first coating layer which is to contact the underlying lens in the in-mold process.

In an embodiment, a second coating layer may be formed by applying a second composition upon a casting surface of a mold and curing the second composition. The second composition, in an embodiment, includes a photoinitiator and an ethylenically substituted monomer. The ethylenically substituted monomers that may be used have been described previously. The initiator may be a photoinitiator, such as was described earlier. The second composition may include other additives such as coinitiators and fluorinated ethylenically substituted monomer. The second composition may, in some embodiments, be substantially free of metal alkoxides. It is believed that metal alkoxides disposed within a composition may interact with the glass and inhibit the removal of the lens from the molds. The second monomers and other additives of the second composition may be dissolved or suspended in an organic solvent. The organic solvent may be used to aid in the application of the monomer to the mold surface.

To apply the second composition to the mold member, the mold member may be spun so that the second composition becomes distributed over the casting face. The mold member is preferably rotated about a substantially vertical axis at a speed up to about 2000 revolutions per minute, preferably at about 850 revolutions per minute. Further, a dispensing device may be used to direct the composition onto the casting face while the

mold member is spinning. The dispensing device may move from the center of the mold member to an edge of the mold member.

After applying the second composition to the mold member, ultraviolet light may be directed at the mold member to cure at least a portion of the second composition. The ultraviolet light may be directed toward either surface (i.e., the casting or non-casting faces) of the mold to cure the second composition.

After the second composition is at least partially cured, a first coating layer may be formed on the second composition by applying a first composition to the second composition. The first composition may include a metal alkoxide. The first composition may also include other additives such as photoinitiators, coinitiators, silane monomers, colloidal silica, ethylenically substituted monomers, and fluorinated ethylenically substituted monomers. The metal alkoxide and other additives may be dissolved in an organic solvent. All of these compounds have been described previously.

The first composition may be cured by a variety of methods. In one embodiment, the first composition may be cured by spinning the lens until the composition forms a gel. Alternatively, the composition may be allowed to sit at room temperature for a time sufficient to allow the composition to gel. In another embodiment, the first composition may be cured by the application of heat to the composition. After the first composition is deposited on the lens and spin dried, the first composition may be in a gelled state. The gelled composition may be heated for a period of about 1-10 minutes at a temperature in the range from about 40 °C to about 120 °C. Heating of the gelled composition in this matter may cause the composition to be converted from a gelled state to a hardened state. In another embodiment, the first composition may be cured by the application of ultraviolet light. As described above, the first composition is applied to the lens and dried to form a gelled composition. The gelled composition may be treated with ultraviolet light for a time sufficient to convert the gelled composition to a hardened state. In some

embodiments, the gelled composition is treated with ultraviolet light for a time of about 60 seconds or less. In one embodiment, the ultraviolet light source may be a germicidal lamp.

After the formation of the first and second coating layers on the casting surface of the mold member, the mold member may be assembled with a second mold member by positioning a gasket between the members to seal them. The second mold member may also include an antireflective coating on the second molds casting surface. The antireflective coating on the second mold may have an identical composition as the antireflective coating on the first mold. Alternatively, the antireflective coatings may have different compositions. The combination of the two molds and gasket form a mold assembly having a cavity defined by the two mold members. The casting surfaces, and therefore the antireflective coatings, may be disposed on the surface of the formed mold cavity.

After the mold assembly has been constructed, a lens forming composition may be disposed within the mold assembly. An edge of the gasket may be displaced to insert the lens forming composition into the mold cavity. Alternatively, the gasket may include a fill port that will allow the introduction of the lens forming composition without having to displace the gasket. This lens forming composition includes a photoinitiator and a monomer that may be cured using ultraviolet light. Examples of lens forming compositions that may be used include, but are not limited to, OMB-99 and PhasesII monomers, as described above. When disposed within the mold cavity, the lens forming composition, in some embodiments, is in contact with the antireflective coating formed on the casting surfaces of the molds.

In some embodiments, an adhesion coating layer may be formed on the partially cured first composition. The coating adhesion layer may be formed from an adhesion composition that is applied to the first coating layer and cured. The adhesion composition may include an ethylenically substituted monomer and a photoinitiator. It is

believed that curing of the first composition may reduce the adhesion of the first coating layer to a subsequently formed plastic lens. The adhesion coating layer may therefore improve the adhesion between the first coating composition and the subsequently formed lens. The adhesion layer composition, in some embodiments, includes monomers similar to the monomers included in the lens forming composition. This may improve the adhesion between the adhesion layer and a lens formed from the lens forming composition. The adhesion layer may have an index of refraction that is similar, or less than, the index of refraction of the formed lens. Thus, the adhesion layer may have little, if any, affect on the antireflective properties of the first and second coating layers.

While two layer antireflective coatings have been described for an in-mold process, it should be understood that multi-layer systems that include more than two layers may also be used. In a two layer system, a mold is coated with a low index of refraction layer. The low index of refraction layer is then coated with a high index of refraction layer. In an embodiment, a third low index of refraction layer (e.g., at least lower than the underlying first coating layer) may be formed on the first coating layer. A fourth high index of refraction layer (e.g., at least higher than the index of refraction of the third coating layer) may also be formed. The four layer stack may exhibit antireflective properties. The four layer stack may have an optical thickness of less than about 1000 nm, and more particularly less than about 500 nm. Additional layers may be formed upon the stack in a similar manner with the layers alternating between high and low index of refraction materials.

In another embodiment, the second coating layer may be formed as a combination of two chemically distinct compositions. The second coating layer may be formed by forming an organic containing layer upon the casting surface of the mold. The organic containing layer includes an ethylenically substituted monomer and an initiator. The ethylenically substituted monomers that may be used have been described previously. The initiator may be a photoinitiator, such as was described earlier. Alternatively, the

initiator may be a metal alkoxide. The organic containing layer may be applied to the casting surface in a manner similar to those described earlier. The organic containing layer may include other monomers such as silane monomers, colloidal silica, coinitiators, and fluorinated ethylenically substituted monomers. The organic containing layer may be cured by the application of ultraviolet light.

The second coating layer may be completed by applying a silicon layer upon the organic containing layer. The silicon layer may be formed from colloidal silica or a silane monomer. The silicon layer is applied to the organic containing layer and at least partially cured. The silicon layer may be cured by drying, heating, or the application of ultraviolet light.

Additional coating materials may be placed onto the antireflective coating. In one embodiment, a hardcoat composition may be applied to the antireflective coating formed on the casting surface of a mold. Curing of the hardcoat composition may create a protective layer on the outer surface of a subsequently formed plastic eyeglass lens. Typically hardcoat compositions are formed from acrylate polymers that, when cured, are resistant to abrasive forces. The subsequently formed hardcoat layer may help to prevent abrasions to the plastic lens. Other coatings that may be formed include hydrophobic coatings and tinted coatings. Such coatings may be formed on the casting surface of the mold, prior to the formation of the antireflective coatings. These coatings, in some embodiments, may allow the formed lens to be removed more easily from the mold assembly. As discussed above, the antireflective coatings may adhere to the molds, making removal of the lens form the mold assembly difficult. The use of hydrophobic coatings may reduce the adhesion between the mold assemblies and the antireflective coating layer.

EXAMPLES

A plastic eyeglass lens was made according to the process described above from the OMB-99 monomer solution. The lens was then coated with two antireflective coating compositions. In all of the examples, the following abbreviations are used:

"AC" is acetone, commercially available from Aldrich;

"AA" is an acrylic amine commercially available as CN384 from Sartomer;

"Al" is aluminum tri-sec-butoxide (98%) commercially available from Avocado;

"AS" is 3-aminopropyltrimethoxysilane (97%) commercially available from Aldrich;

"BDK", "BDM", and "BDMK" are Photomer 51 and 2,2-dimethoxy-2-phenylacetophenone commercially available from Henkel;

"BYK300" is a solution of polyether modified dimethylpolysiloxane copolymer commercially available from BYK Chemie;

"CD1012" is diaryl iodonium hexafluoroantimonate commercially available from Sartomer;

"CD540" is ethoxylated bisphenol A dimethacrylate commercially available from Sartomer;

"CN124" is epoxy acrylate commercially available from Sartomer;

"Cynox 1790" is tris(4-t-butyl-3-hydroxy-2,6-dimethylbenzyl)-s-triazine-2,4,6-(1H,3H,5H)-trione commercially available from Sartomer;

"D1173" is 2-hydroxy-2-methyl-1-phenyl-propan-1-one (HMPP) commercially available from Ciba;

"DC193" is a surfactant commercially available from Dow Corning;

"ECHMCHC" is 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate;

"Eosin" is the dye Eosin Y commercially available from Aldrich;

"EtOH" is ethanol, commercially available from Fisher;

"FC40" and "FC430" are surfactants commercially available from 3M;

"FC-171" is a fluorochemical surfactant commercially available from 3M;

"FC-725" also known as FLUORAD, a fluorochemical surfactant commercially available from 3M;

"GPTMS" is 3-glycidoxypropyltrimethoxysilane commercially available from Aldrich;

"HC-8" is a hard coat forming composition commercially available from Fastcast Co. and includes a mixture of SR399, SR601, Irg184, and MP;

"HC8558" is commercially available from GE;

"HC-900" is commercially available from Coburn Optical Industries;

"HEMA" is hydroxyethyl methacrylate commercially available from Coburn Optical Industries;

"HR-200" is a hydrophobic coating commercially available from Group Couget;

"IPA" is isopropyl alcohol commercially available from Fisher;

"Irg 184" is Irgacure 184 or 1-Hydroxycyclohexyl phenyl ketone commercially available from Ciba;

"Irg 261" is Irgacure 261 or iron (.eta.5-2,4-cyclopentadien-1-yl)[1,2,3,4,5,6-.eta.)-(1-methylethyl)benzene]-hexafluorophosphate) commercially available from Ciba;

"Irg 819" is Irgacure 819 or Phosphine oxide, phenylbis(2,4,6-trimethyl benzoyl) commercially available from Ciba;

"MP" is 1-methoxy-2-propanol commercially available from Arcos;

"Nalco Si2326" is a colloidal silica commercially available from Nalco Chemical Company;

"NNDMEA" is N,N-dimethylethanolamine commercially available from Aldrich;

"PerenolS-5" is a modified polysiloxane commercially available from Henkel;

"PFOA" is 1H,1H-perfluorooctyl acrylate commercially available from Lancaster;

"PFOFCS" is 1H,1H,2H.2H-perfluorooctyltrichlorosilane commercially available from Lancaster;

"PFOMA" is perfluorooctyl methacrylate commercially available from Lancaster;

"Q4DC" is an organic functional silicone fluid commercially available from Dow Corning;

"Si" is MA-ST-S (30% colloidal silica in 70% methanol) commercially available from Nissan Chemical;

"SR123" is an acrylate monomer commercially available from Sartomer;

"SR306" is tripropylene glycol diacrylate commercially available from Sartomer;

"SR313" is lauryl methacrylate commercially available from Sartomer;

"SR368" is tris(2-hydroxy ethyl) isocyanurate triacrylate commercially available from Sartomer;

"SR399" is dipentacrythritol tetraacrylate commercially available from Sartomer;

"SR423" is isobornyl methacrylate commercially available from Sartomer;

"SR444" is Pentaerythritol triacrylate commercially available from Sartomer;

"SR640" is tetrabromo bisphenol A diacrylate commercially available from Sartomer;

"SR9003" is propoxylated neopentyl glycol diacrylate commercially available from Sartomer;

"T770" is bis(2,2,6,6-tetramethyl-4-piperidinyl sebacate commercially available from Ciba;

"TEA" is triethylamine commercially available from Aldrich;

"TFEMA" is trifluoroethyl methacrylate commercially available from Cornelius Chemical;

"Ti" is titanium (IV) isoproxide commercially available from Aldrich;

"Ti-Bu" is titanium (IV) butoxide commercially available from Aldrich;

"TMSPMA" is 3-(trimethoxysilyl)propyl methacrylate commercially available from Aldrich;

"TPB" is thermoplast blue 684;

"TPR" is thermoplast red 454;

"TX-100" is a surfactant commercially available from Aldrich;

"ZelecUN" is a lubricant commercially available from Stepan; and

"Zr" is zirconium (IV) propoxide commercially available from Aldrich.

In Table 1, Layer 1 refers to the first antireflective coating layer, Layer 2 refers to the second antireflective coating layer. Solutions of each of the components were prepared and used to form the antireflective coatings. For all of the compositions listed in Table 1, the remainder of the composition is made up of 1-methoxy-2-propanol. For

example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The plastic eyeglass lens was coated using two different coating compositions. The "Layer 1" composition was added to a surface of the eyeglass lens and the eyeglass lens was rotated on a lens spin-coating apparatus. After the L1 composition was spread onto the eyeglass lens surface the solvent was allowed to substantially evaporate and the remaining composition was subjected to ultraviolet light from the germicidal lamp from the previously described coating unit for about 60 seconds. In some instances, more or less UV light was applied. Alternate times are noted in parenthesis. The "Layer 2" composition was added to the eyeglass lens after the Layer 1 composition was cured. The eyeglass lens was spun on a lens spin-coating apparatus until the solvent was substantially evaporated. Layer 2 was then cured by the application of ultraviolet light from the germicidal lamp from the previously described coating unit. Curing time of the second layer is 60 seconds, unless otherwise noted. The % transmittance refers to the amount of light transmitted through the lens after the Layer 2 composition was cured. The transmittance was measured in a BYK Gardner Haze Guard Plus Meter, available from BYK Gardner, Silver Springs, MD. Transmission readings were taken of an uncoated lens to use as a control standard. The visible light transmittance of an uncoated lens measured with the convex face of the lens positioned against the haze port of the BYK Gardner Haze Guard Plus Meter is about 92%. Color refers to the color of the light reflected from the coated lens.

TABLE 1

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
1	5% Ti	5.1%Si 1.04%Ti 1.04%GPTMS 0.144%HC-900 (Heat 20 Min.)	99.0%	RED
2	5% Ti	4.25%Si 0.87%GPTMS 0.17HC-900 (Heat 20 Min.)	99.0%	
3	5%Ti	4.5%Si 1.8%Ti 1.8%GPTMS 0.17%HC-900 (Heat 20 Min.)	96.0%	PURPLE
4	5%Ti	4.25%Si 1.04%Ti 0.87%GPTMS 0.17%HC-900 (Heat 20 Min.)	99.0%	
5	5%Ti	4.5%Si 1.8%Ti 1.8%GPTMS 0.17%HC-900	97.4%	BLUE
6	3%Ti	4.5%Si 1.8%Ti 1.8%GPTMS 0.17%HC-900	97.0%	PURPLE
7	3%Ti	3%Si 1.2%Ti 1.2%GPTMS 0.11%HC-900	93.0%	
8	3%Ti	5.4%Si 1.17%Ti 1.17%GPTMS 0.107%HC-900	97.7%	RED
9	5%Ti	5.4%Si 1.17%Ti 1.17%GPTMS 0.107%HC-900	99.0%	PURPLE
10	5.2%Ti 1.33%Si 1.33%GPTMS	5.4%Si 1.17%Ti 1.17%GPTMS 0.107%HC-900	96.0%	
11	4.13%Ti 0.66%Si 0.66%GPTMS	5.4%Si 1.17%Ti 1.17%GPTMS 0.107%HC-900 (Heat 5 Min.)	>97%	
12	5.4%Ti 0.32%Si 0.32%GPTMS 0.053%HC-900 (UV 90 s)	5.4%Si 1.17%Ti 1.17%GPTMS 0.107%HC-900	98.0%	
13	3%Ti	0.45%Al 0.445%Ti 3.5%GPTMS 3.5%TMSPMA	97.0%	

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
14	3%Ti	0.3%Al 0.36%Ti 2%GPTMS 2%TMSPMA 0.01%TBPO 0.08%FC-430	97.7%	
15	3%Ti	0.62%Al 0.17%Ti 1.2%GPTMS 1.2%TMSPMA 3.87%HC-8	>97%	
16	2.8%Ti 0.49%Al 2.79%HC-8	0.62%Al 0.17%Ti 1.2%GPTMS 1.2%TMSPMA 3.87%HC-8	>96%	
17	3%Ti	0.54%Al 0.5%Ti 0.82%GPTMS 0.9%TMSPMA 1.27%HC-8	94.4%	
18	3%Ti	0.9%Al 0.46%Ti 0.75%GPTMS 0.83%TMSPMA 3.43%HC-8	97.3%	
19	3%Ti	0.8%Al 0.1%Ti 0.42%GPTMS 0.42%TMSPMA 6%HC-8	97.0%	
20	3%Ti	0.62%Al 0.17%Ti 1.2%GPTMS 1.2%TMSPMA 3.9%HC-8	97.0%	
21	10%Ti 0.05%AA 22.7%MP 67.25%IPA	0.19%Ti 0.19%GPTMS 0.19%TMSPMA 1.9%HC-8 3.9%Si	>97%	
22	10%Ti 0.05%AA 22.7%MP 67.25%IPA	0.46%Ti 0.9%Al 0.8%GPTMS .75%TMSPMA 3.4%HC-8	96.2%	
23	2%Ti 100ppmAA 25.2%MP 72.8%IPA (UV 60 s)	0.3%Al 18.5%HC-8 (UV 60 s)	92.5%	
24	2%Ti 100ppmAA 25.2%MP 72.8%IPA (UV 60 s)	0.11%Al 3.35%SR368 (UV 200 s)	92.8%	
25	1.54%Ti 77ppmAA 42.3%MP 56.2%IPA (UV 86 s)	0.24%Ti 0.048%Al 1.94%SR368 1.47%TMSPMA 96.3%MP (UV 180s)	96.3%	

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
26	1 54%Ti 77ppmAA 42.3%MP 56.2%IPA (UV 40 s)	0.186%Ti 0.036%Al 1.48%SR368 1.13%TMSPMA 0.02%DC193 97.17%MP (UV 180 s)	97.2%	
27	1.54%Ti 77ppmAA 42.3%MP 56.2%IPA (UV 40 s)	0.36%Ti 0.033%Al 1.39%SR368 1.06%TMSPMA 0.0187%DC193 97.16%MP (UV 10 s)	96.8%	
28	2.8%Ti 2.8%Irg184 (UV 20 s)	2%SR399	96.8%	
29	2.99%Ti 0.294%Irg184 (UV 20 s)	1.86%SR399 0.31%Ti (UV 30 s)	95.7%	
30	2.99%Ti 0.28%Irg184 (UV 40 s)	2%SR399 0.349%Ti (UV 30 s)	95.7%	GOLD
31	2.99%Ti 0.28%Irg184	0.34Ti 0.5%SR306 2%SR399 (UV 120s)	95.7%	DEEP BLUE
32	2.99%Ti 0.28%Irg184 (UV 40 s)	2%SR399 0.5%SR306 0.349%Ti (UV 100 s)	95.8%	
33	2%Ti 0.2Irg184 (UV 30 s)	2%SR399 0.4%Ti 0.04%Irg184 (UV 30 s)	95.2%	GOLD
34	2%Ti 0.2%Irg184 (X3) (UV 20s each)	2%SR399 0.4%Ti 0.04%Irg184 (UV 60 s)	97.1%	
35	2%Ti 0 2Irg184 (UV 30 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%BYK300 (UV 30 s)	95.6%	
36	3.25%Ti 0.1%Irg184 (UV 30 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%BYK300 (UV 30 s)	97.2%	GOLD
37	3.25%Ti 0.1%Irg184 (350 rpm)	2%SR399 0.4%Ti 0.04%Irg184 0.1%BYK300 (UV 30 s)	97.9%	
38	3.25%Ti 0.1%Irg184 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%BYK300 (UV 60 s)	97.5%	GOLD

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
39	2%Ti 0.2%Irg184 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.12%Zelecun (UV 60 s)	96.0%	
40	2%Ti 0.2%Irg184 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%Q4DC	96.0%	
41	3.25%Ti 0.1%Irg184 (UV 70 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%Q4DC (UV 70 s)	97.4%	
42	3.25%Ti 0.1%Irg819 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%Q4DC (UV 70 s)	97.4%	
43	3.03%Ti 0.4%Irg819 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%Q4DC (UV 70 s)	96.9%	
44	2.5%Ti 0.16%Irg184 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.13%FC430 (UV 60 s)	96.5%	
45	3.5%Ti 0.08%Irg184 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 (UV 60 s)	97.5%	
46	3.5%Ti 0.08%Irg184 (UV 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%FC430 0.1% BYK300 (UV 60 s)	98.1%	
47	3.5%Ti 0.08%Irg184 (UV 20 s)	2%SR399 0.4%Ti 0.04%Irg184 0.13%FC430 0.1% BYK300 (UV 60 s)	98.3%	
48	2.5%Ti 0.2%Irg184 44.8%AC 52.5%MP	0.2%Ti 0.2%SR239 0.8%SR399	95.2%	
49	2.46%Ti 0.197Irg184 0.157%SR313 44.3%AC (UV 60 s)	0.5%Ti 0.1%Irg184 0.55%SR313 1.75%SR399	97.5%	
50	3.47%Ti 0.294%Irg184 (UV 30 s)	0.5%Ti 0.1%Irg184 0.55%SR313 1.75%SR399	96.9%	

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
51	2.5%Ti 0.2%Irg184 45%AC 52.3%MP (UV 60 s)	0.5%Ti 0.1%Irg184 0.55%SR313 1.75%SR399	97.5%	
52	2.47%Ti 0.197%Irg184 0.12%SR313 44.47%AC (UV 60 s)	0.53%Ti 0.1%Irg184 0.85%SR313 1.38%SR399 (UV 60 s)	97.0%	
53	2.47%Ti 0.197%Irg184 0.12%SR313 44.47%AC (UV 60 s)	0.57%Ti 0.087%Irg184 1.74%CN124 (UV 60 s)	95.0%	
54	2.47%Ti 0.197%Irg184 0.12%SR313 44.47%AC	0.5%Ti 0.19%Irg184 0.6%CN124 0.4%SR313 1.07%SR399 (UV 60 s)	96.8%	
55	2.47%Ti 0.197%Irg184 0.12%SR313 44.47%AC	0.167%Ti 0.083%Irg184 0.167%Al 1.555%SR399	96.7%	
56	2.47%Ti 0.197%Irg184 0.12%SR313 44.47%AC	0.35%Ti 0.076%Irg184 0.15%Al 1.43%SR399 0.414%SR313	97.1%	
57	5%Ti	2%CD540 0.5%Ti 3.4ppmTPB 0.2ppmTPR 12ppmCynox-1790	97.6%	
58	5%Ti	0.21%Irg184 1.93%CD540 0.48%Ti 3.3ppmTPB 0.19ppmTPR 11.6ppmCynox-1790	97.4%	
59	5%Ti	0.084%Irg 184 0.77%CD540 0.192%Ti 1.3ppmTPB 0.075ppmTPR 4.6ppm-Cynox-1790	98.5%	
60	5%Ti (UV 60 s)	2%ECHMCHC 0.5%Ti	97.6%	
61	5%Ti (UV 40 s)	0.12%CD1012 1.88%ECHMCHC 0.47%Ti (UV 90 s)	98.1%	
62	5%Ti (UV 30 s)	0.22%CD1012 2%ECHMCHC 0.43%Ti (UV 90 s)	95.0%	
63	5%Ti (UV 60 s)	0.22%CD1012 2%ECHMCHC 0.43%Ti (UV 90 s)	94.0%	

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
64	5%Ti	0.356Ti 0.073CD1012 0 67%ECHMCHC 1 33%SR399	98.4%	
65	5%Ti (UV 50 s)	0 14%Irg184 0.348%Ti 0.07%CD1012 0.65%ECHMCHC 1.3%SR399 (Heat)	98.3%	
66	5%Ti (UV 45 s)	0.133%Irg184 0.33%Ti 0.066%CD1012 0.62%ECHMCHC 1.24%SR399 0.1%PerenolS-5 (Heat)	96.4%	
67	3%Ti (UV 60 s)	2.6%SR399 0.3%Ti (UV 60 s)	96.7%	
68	5%Ti (UV 60 s)	2.6%SR399 0.3%Ti (UV 60 s)	94.4%	
69	3%Ti (UV 60 s)	2.6%SR399 0.3%Ti (UV 60 s)	96.2%	
70	3%Ti (UV 60 s)	2.0%SR399 0.3%Ti (UV 60 s)	97.2%	
71	2.5%Ti 2.5%HEMA	2%SR399 0.06%Irg184	96.2%	
72	1.5%Ti 1.5%HEMA	2%SR399 0.06%Irg184	95.3%	
73	1.5%Ti 1.5%HEMA 9.3ppmAA 13.3%IPA	2%SR399 0.06%Irg184	97.0%	
74	3%Ti (UV 60 s)	0.0525%PFOFCS 0.144%CD1012 1.955%ECHMCHC (UV 60 s)	95.6%	
75	3%Ti (UV 60 s)	0.0256%PFOFCS 0.145%CD1012 1.978%ECHMCHC (UV 60 s)	97.0%	
76	3%Ti (UV 60 s)	0.0232%PFOFCS 0.476%Ti 0.131%CD1012 1.79%ECHMCHC (UV 60 s)	96.8%	
77	3%Ti (UV 60 s)	0.051%PFOFCS 0.139%CD1012 1.89%ECHMCHC 0.49%HEMA (UV 60 s)	97.3%	

Ex. #	Layer 1	Layer 2	Visible Light Transmittance %	Color
78	3%Ti (UV 60 s)	0.0477%PFOFCS 0.13%CD1012 1.767%ECHMCHC 0.78%HEMA 0.32%Ti (UV 60 s)	96.9%	
79	3%Ti (UV 60 s)	0.0457%PFOFCS 0.124%CD1012 0.26%Irg184 1.685%ECHMCHC 0.746%HEMA 0.306%Ti (UV 60 s)	97.5%	
80	3%Ti (UV 60 s)	0.11%Irg184 0.44%Ti 2%SR399 (UV 60 s)	97.1%	
81	5%Si (UV 60 s)	0.05%Irg184 5%Ti 0.19%SR399 (UV 60 s)	93.8%	
82	5%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOTCS (UV 60 s)	92.6%	
83	3.1%Ti-Bu 1.1%HEMA 13.3%IPA	2%SR399 0.08%Irg 184	96.3%	
84	3.1%Ti-Bu 1.1%HEMA 13.3%IPA	2%SR399 0.08%Irg 184	96.3%	
85	4%Ti	2%SR399 0.08%Irg184 0.32%Ti-Bu	97.7%	

In Table 2, Layer 1 refers to the first antireflective coating layer, Layer 2 refers to the second antireflective coating layer. HR-200 refers to a hydrophobic coating layer formed upon Layer 2. Solutions of each of the components were prepared and used to form the antireflective coatings. For all of the compositions listed in Table 2, the remainder of the composition is made up of 1-methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The application of the compositions to the lenses, and the measurement of the transmittance was performed in substantially the same manner as recited above for Table 1. Curing times are 60 seconds, unless otherwise noted.

TABLE 2

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
86	3%Ti	4.65%Si 0.7%Ti 0.05%HC-900	HR-200	>98%	
87	1.5%Ti 454ppmAA 300ppmAS 92.8%MP 5.6%IPA (UV 40 s)	0.46%Ti 0.75%GPTMS 0.83%TMSPMA 3.4%HC-8 0.9%Al	HR-200	97.3%	
88	0.75%Ti 38ppmAA 14 2%MP 85%IPA	0.46%Ti 0.75%GPTMS 0.83%TMSPMA 3.4%HC-8 0.9%Al	HR-200	96.0%	
89	2%Ti 100ppmAA 25.2%MP 72.8%IPA (UV 60 s)	0.24%Al 9.8%HC-8 (UV 60 s)	HR-200	94.7%	
90	2%Ti 100ppmAA 25.2%MP 72.8%IPA (UV 60 s)	0.09%Al 2.8%SR368 0.32%Ti 16ppmAA 11.7%IPA (UV 90 s)	HR-200	93.5%	
91	2%Ti 100ppmAA 25.2%MP 72.8%IPA	0.41%Ti 0.045%Al 1.4%SR368 0.88%SR123 0.78%TFEMA 8ppmAA 5.8%IPA (UV 90 s)	HR-200	94.6%	
92	1%Ti 50ppmAA 12.6%MP 86.4%IPA (UV 30 s)	0.13%Ti 0.031%Al 1.52%SR368 0.467%SR123 0.417%TFEMA (UV 60 s)	HR-200	94.8%	
93	1%Ti 50ppmAA 12.6%MP 86.4% IPA (UV 40 s)	0.21%Ti 0.35%Al 2.4%SR368 0.74%SR123 0.66%TFEMA (UV 60 s)	HR-200	96.7%	
94	1.54%Ti 77ppmAA 42.3%MP 56.2%IPA (UV 30 s)	0.19%Ti 0.037%Al 1.5%SR368 1.14%TMSPMA 97.16%MP (UV 180 s)	HR-200	96.9%	

In Table 3, multiple coating layers are formed on the plastic lens. For all of the compositions listed in Table 3, the remainder of the composition is made up of 1-

methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The application of the compositions to the lenses, and the measurement of the transmittance was performed in substantially the same manner as recited above for Table 1. Curing times are 60 seconds, unless otherwise noted.

TABLE 3

Ex. #	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Visible Light Transmittance %	Color
95	2 5%Ti 2 5%Si	10%Ti	0 7%Ti 4 6%Si 0 05%HC900	HR200				96 8%	BLUE
96	2%Ti 57ppmNNDMEA (UV 30 s)	0 368%Al (UV 40 s)	26 8%HC-8 73 2%IPA	HR200				96 0%	
97	3%Ti (UV 70 s)	0 055%Irg184 0 22%Ti 1%SR399 0 0125PFOMA (UV 20 s)	3%Si (UV 20 s)	0 055%Irg184 0 22%Ti 1%SR399 0 0125%PFOMA (UV 70 s)				97 2%	
98	3%Ti (UV 70 s)	0 055%Irg184 0 22%Ti 1%SR399 0 0125PFOMA (UV 20 s)	3 7%Natco Si (UV 20 s)	0 055%Irg184 0 22%Ti 1%SR399 0 0125%PFOMA				97 9%	
99	3%Ti (UV 60 s)	0 54%SR399 0 12%Ti 0 03%Irg184 0 07%PFOMA 45 4%AC (UV 20 s)	0 54%SR399 0 12%Ti 0 03%Irg184 0 07%PFOMA 45 4%AC (UV 20 s)	0 54%SR399 0 12%Ti 0.03%Irg184 0 07%PFOMA 45.4%AC (UV 20 s)				97 5%	
100	3%Ti	0 527%SR399 0 235%Ti 0 029%Irg184 0 066%PFOMA 44 3%AC	0 527%SR399 0 235%Ti 0 029%Irg184 0 066%PFOMA 44 3%AC (UV 20 s)	0 54%SR399 0 12%Ti 0 03%Irg184 0 07%PFOMA 45 4%AC (UV 60 s)				96 1%	
101	1 5%Ti	0 525%SR399 0 235%Ti 0 029%Irg184 0 066%PFOMA	3%Si	0 527%SR399 0 23%Ti 0 024%Irg184 0 066%PFOMA				97 0%	
102	3 5%Ti-Bu	0 033%BDKK 0 095%Ti-Bu 0 375%SR399 2 5%Si	0 086%BDKK 0 173%Ti-Bu 1%SR399	0 026%BDKK 0 3%SR399 0 0037%PFOTCS 0 0037%FC430 0 0037%BYK300				97 5%	
103	5%Ti-Bu (UV 60 s)	0 086%BDKK 0 17%Ti-Bu 1%SR399 (UV 40 s)	0 086%BDKK 0 17%Ti-Bu 1%SR399 (UV 50 s)	0 026%BDKK 0 3%SR399 0 0037%PFOTCS 0 0037%FC430 0 0037%BYK300 (UV 60 s)				98 1%	
104	5%Ti-Bu (UV 60 s)	0 033%BDKK 0 095%Ti-Bu 0 375%SR399 2 5%Si (UV 40 s)	0 086%BDKK 0 17%Ti-Bu 1%SR399 (UV 50 s)	0 026%BDKK 0 3%SR399 0 0037%PFOTCS 0 0037%FC430 0 0037%BYK300 (UV 60 s)				97 9%	
105	5%Ti-Bu (UV 60 s)	0 033%BDKK 0 095%Ti-Bu 0 375%SR399 2 5%Si (UV 40 s)	0 033%BDKK 0 095%Ti-Bu 0.375%SR399 2.5%Si (UV 50 s)	0.026%BDKK 0.3%SR399 0.0037%PFOTCS 0.0037%FC430 0 0037%BYK300 (UV 60 s)				98 2%	
106	5%Ti-Bu (UV 60 s)	0 086%BDKK 0 17%Ti-Bu 1%SR399 (UV 50 s)	0 033%BDKK 0 095%Ti-Bu 0 375%SR399 2.5%Si (UV 60 s)	0 026%BDKK 0.3%SR399 0 0037%PFOTCS 0.0037%FC430 0 0037%BYK300				97 9%	
107	2%Ti (UV 50 s)	5%Si 0.4%SR399 0 067%Ti	5%Ti	5%Si 0 4%Ti 0 06%Irg184	1%SR399 0.17%Ti 0.0416%Irg184			97 5%	
108	2%Ti (UV 50 s)	5%Si 0 4%SR399 0 067%Ti	5%Ti	2%Si 0 0346%Ti 0.2%SR399 0 0346%Ti 0 0085%Irg184	0 2%SR399			97 7%	
109	2%Ti (UV 50 s)	1%SR399 0 17%Ti 0.0416%Irg184 (UV 50 s)	2%Ti (UV 30 s)	2%Ti (UV 40 s)	0 1% SR399			96.8%	

Ex. #	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Visible Light Transmittance %	Color
110	1 5%Ti (UV 60 s)	2%SR399 0 5%Si 0 1%Irg184 0 3%Ti (UV 60 s)	2 75%Ti	1%SR399 1%Si 0 05%Irg184 0 3%Ti	1 4%SR399 0 062%Irg184 0 3%Ti (UV 60 s)			96 4%	
111	1 5%Ti (UV 60 s)	1%SR399 1%Si 0 05%Irg184 0 3%Ti (UV 60 s)	2 75%Ti	1%SR399 1%Si 0 05%Irg184 0.3%Ti	1%SR399 0 05%Irg184 0 21%Ti (UV 60 s)			95 1%	
112	1 5%Ti (UV 60 s)	2%SR399 0 5%Si 0.1%Irg184 0 3%Ti (UV 60 s)	2 75%Ti	1%SR399 1%Si 0 05%Irg184 0 3%Ti	1%SR399 0.05%Irg184 0 21%Ti	0 4%SR399 0 017%Irg184 0 085%Ti		96 1%	
113	1 5%Ti (UV 60 s)	0 33%SR399 3%Si 0 017%Irg184 0 3%Ti	2 75%Ti	1%SR399 1%Si 0 05%Irg184 0 3%Ti	1%SR399 0 05%Irg184 0 21%Ti	0 4%SR399 0 017%Irg184 0 085%Ti		94 7%	
114	1 5%Ti	0 33%SR399 3%Si 0 017%Irg184 0 3%Ti	2 75%Ti	1%SR399 1%Si 0 05%Irg184 0 3%Ti	0 8%SR399 0 035%Irg184 0 17%Ti			97 5%	
115	1 5%Ti	0 33%SR399 3%Si 0 017%Irg184 0 3%Ti	2.75%Ti	0 33%SR399 3%Si 0.017%Irg184 0 3%Ti	0 8%SR399 0 035%Irg184 0 17%Ti			97 5%	
116	2 75%Ti (UV 50 s)	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si (UV 50 s)	2 75%Ti (UV 50 s)	2 75%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	1 3%SR399 0 065%Irg184 0 245%Ti 0 58%Si		95 6%	
117	2.75%Ti (UV 50 s)	1.3%SR399 0 065%Irg184 0 245%Ti 0 58%Si (UV 50 s)	2 75%Ti (UV 50 s)	2 75%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	1 3%SR399 0 065%Irg184 0 245%Ti 0 58%Si		95 4%	
118	1 5%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	2 75%Ti	1 5%Ti	1 3%SR399 0 065%Irg184 0 245%Ti 0 58%Si	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si		96 7%	
119	1 5%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	2.75%Ti	1 5%Ti	1 4%SR399 0 062%Irg184 0 3%Ti	0 596%SR399 0 03%Irg184 0.3%Ti 2 2%Si		97 2%	
120	1 5%Ti (UV 50 s)	0.8%SR399 0 035%Irg184 0 17%Ti (UV 50 s)	4%Ti (UV 50 s)	0 596%SR399 0.03%Irg184 0.3%Ti 2 2%Si	1.4%SR399 0 062%Irg184 0 3%Ti (UV 50 s)			97 6%	
121	1.5%Ti (UV 50 s)	1%SR399 0 05%Irg184 0 21%Ti (UV 50 s)	4%Ti (UV 50 s)	0.596%SR399 0 03%Irg184 0 3%Ti 2.2%Si	1 4%SR399 0 062%Irg184 0 3%Ti (UV 50 s)			97 2%	
122	1.5%Ti	1 4%SR399 0 062%Irg184 0.3%Ti	4%Ti	0.596%SR399 0.03%Irg184 0 3%Ti 2.2%Si	1.4%SR399 0 062%Irg184 0 3%Ti (UV 70 s)	0.4%SR399 0.017%Irg184 0 085%Ti		96.9%	
123	1 5%Ti	0 4%SR399 0 017%Irg184 0 085%Ti	4%Ti	0 596%SR399 0.03%Irg184 0.3%Ti 2.2%Si	1 4%SR399 0 062%Irg184 0 3%Ti (UV 70 s)			98 2%	
124	2%Ti (UV 60 s)	1 4%SR399 0 062%Irg184 0.3%Ti (UV 60 s)	4%Ti	0.596%SR399 0 03%Irg184 0.3%Ti 2.2%Si	0 596%SR399 0.03%Irg184 0 3%Ti 2 2%Si	1 4%SR399 0 062%Irg184 0.3%Ti		96.4%	
125	2%Ti (UV 60 s)	1%SR399 0.05%Irg184 0.21%Ti (UV 60 s)	4%Ti	0.596%SR399 0.03%Irg184 0.3%Ti 2 2%Si	0 596%SR399 0.03%Irg184 0.3%Ti 2 2%Si	1 4%SR399 0 062%Irg184 0.3%Ti		96.5%	

Ex. #	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Visible Light Transmittance %	Color
126	2%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	4%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	1 4%SR399 0 062%Irg184 0 3%Ti (UV 60 s)		95 3%	
127	2%Ti	0 596%SR399 0.03%Irg184 0 3%Ti 2 2%Si	4%Ti	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si	0 596%SR399 0 03%Irg184 0 3%Ti 2 2%Si (UV 60 s)	0 4%SR399 0 017%Irg184 0 085%Ti (UV 60 s)		96 1%	
128	2 75%Ti	0 6%SR399 0 03%Irg184 0 3%Ti 4 4%Si	4%Ti	0.6%SR399 0 03%Irg184 0 3%Ti 4 4%Si	1 3%SR399 0 065%Irg184 0 245%Ti 0 58%Si	1%SR399 0 05%Irg184 0 21%Ti	0.1%Ti 0 1%PFOTCS EtOH (UV 60 s)	97 0%	RED
129	2 75%Ti	1 4%SR399 0 062%Irg184 0 31%Ti	5%Ti	0 4%SR399 0 017%Irg184 0 085%Ti	0 6%SR399 0 03%Irg184 0 3%Ti 4 4%Si	1 4%SR399 0 062%Irg184 0 31%Ti	0 1%Ti 0 1%PFOTCS EtOH	96 9%	BLUE
130	1 75%Ti (UV 60 s)	0 9%SR399 0 042%Irg184 0 19%Ti (UV 60 s)	4%Ti (UV 60 s)	0 6%SR399 0 03%Irg184 0 3%Ti 3 3%Si (UV 60 s)	0 9%SR399 0 042%Irg184 0 19%Ti (UV 60 s)	0 01%PFOA 0 01%PFOMA 0 005%PFOTCS 0 1%Ti 0 007%TBPO 4%MP 95 9%IPA (UV 50 s)		96 6%	BLUE
131	1 75%Ti (UV 60 s)	0 6%SR399 0 03%Irg184 0 3%Ti 3 3%Si (UV 60 s)	4%Ti (UV 60 s)	0 6%SR399 0 03%Irg184 0 3%Ti 3 3%Si (UV 60 s)	0 9%SR399 0 042%Irg184 0 19%Ti (UV 60 s)	0 01%PFOA 0 01%PFOMA 0 005%PFOTCS 0 1%Ti 0 007%TBPO 4%MP 95 9%IPA (UV 50 s)		96 9%	YELLOW-RED
132	1 75%Ti	0 9%SR399 0 042%Irg184 0 19%Ti	1 75%Ti (UV 60 s)	1 75%Ti (UV 60 s)	0 6%SR399 0 03%Irg184 0.3%Ti 3 3%Si (UV 30 s)	0 9%SR399 0 042%Irg184 0 19%Ti (UV 60 s)		96 1%	
133	1 75%Ti	0 9%SR399 0 042%Irg184 0 19%Ti	1 75%Ti (UV 60 s)	1 75%Ti (UV 60 s)	0 6%SR399 0 03%Irg184 0.3%Ti 3 3%Si (UV 30 s)	0 9%SR399 0 042%Irg184 0 19%Ti (UV 60 s)		96 5%	
134	1 75%Ti	1 4%SR399 0 3%Ti	5%Ti	0 6%SR399 0 03%Irg184 0.3%Ti 3 3%Si	1 4%SR399 0 3%Ti (UV 60 s)			97 6%	
135	1 75%Ti	1 4%SR399 0.3%Ti	5%Ti	0 6%SR399 0 03%Irg184 0 3%Ti 3 3%Si	0 9%SR399 0.042%Irg184 0 19%Ti (UV 60 s)			96 8%	
136	1 15%Ti-Bu 0 84%Ti 0 55%SR399 0 068%Irg184 18 5ppmBYK300 18 5ppmPFOMA	1 15%Ti-Bu 0.84%Ti 0 55%SR399 0 068%Irg184 18 5ppmBYK300 18 5ppmPFOMA	3 85%Ti-Bu 0.25%SR399 0 017%Irg184 8ppmBYK300 8ppmPFOMA	1 5%SR399 0.1%Irg184 50ppmBYK300 50ppmPFOMA				95 4%	
137	1 15%Ti-Bu 0 84%Ti 0 55%SR399 0 068%Irg184 18 5ppmBYK300 18 5ppmPFOMA	2.5%Si (UV 60 s)	1.15%Ti-Bu 0 84%Ti 0.55%SR399 0 068%Irg184 18 5ppmBYK300 18.5ppmPFOMA	3.85%Ti-Bu 0 25%SR399 0 017%Irg184 8ppmBYK300 8ppmPFOMA	1.5%SR399 0 1%Irg184 50ppmBYK300 50ppmPFOMA	0 085%Ti-Bu 0 4%SR399 0 017%Irg184		96 4%	RED-GREEN

In Table 4, three coating layers are formed on the plastic lens. For all of the compositions listed in Table 4, the remainder of the composition is made up of 1-

methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The application of the compositions to the plastic lens, and the measurement of the transmittance was performed in substantially the same manner as recited above for Table 1. Curing times are 60 seconds, unless otherwise noted.

TABLE 4

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
138	2%Ti 0.02% NNDMEA (UV 30 s)	0.186%Al (UV 40 s)	26.8%HC-8 73.2%IPA	94.0%	
139	1 54%Ti 77ppmAA 42.3%MP 56.2%IPA	0.24%Ti 0.048%Al 1.94%SR368 1.47%TMSPMA 96.3%MP (UV 180 s)	0.3%Al (UV 50 s)	93.0%	
140	2.99%Ti 0.28%Irg184 (UV 20 s)	2.99%Ti 0.28%Irg184 (UV 20 s)	2%SR399 0.349%Ti (UV 30 s)	97.3%	
141	0.3%Al (UV 20 s)	2.99%Ti 0.28%Irg184 (UV 40 s)	2%SR399 0.5%SR306 0.349%Ti (UV 100 s)	95.5%	
142	2.97%Ti 0.29%Irg184 1%SR368 (UV 30 s)	2.99%Ti 0.28%Irg184	2%SR399 0.5%SR306 0.349%Ti	93.6%	
143	1.69%Ti 0.168%Irg184 0.58%SR368	2.99%Ti 0.28%Irg184	2%SR399 0.5%SR306 0.349%Ti	94.5%	
144	3.25%Ti 0.1%Irg184 (UV 30 s, 350 rpm)	3.25%Ti 0.1%Irg184 (UV 30 + 60 s)	2%SR399 0.4%Ti 0.04%Irg184 0.1%BYK300 (UV 60 s)	93.0%	GREENISH BLUE
145	0.5%Ti 0.25%Irg184 0.5%Al 4.67%SR399	2.46%Ti 0.197%Irg184 0.157%SR313 44.3%AC	0.53%Ti 0.1%Irg184 0.85%SR313 1.38%SR399	97.3%	
146	3%Ti (UV 60 s)	3%HEMA 0.25%Ti 0.33%TEA 0.02%Eiosin (UV 60 s)	0.06%Irg184 0.32%Ti 2%SR399 (UV 60 s)	97.4%	
147	3%HEMA 0.25%Ti 0.33%TEA 0.02%Eiosin (UV 60 s)	3%Ti (UV 60 s)	0.06%Irg184 0.32%Ti 2%SR399 (UV 60 s)	97.5%	
148	3%Ti (UV 60 s)	2.5%HEMA 0.25%T770 0.5%Ti	0.06%Irg184 0.32%Ti 2%SR399 (UV 60 s)	97.4%	
149	3%Ti (UV 60 s)	2.5%HEMA 0.25%T770 0.5%Ti (UV 60 s)	0.06%Irg184 0.32%Ti 2%SR399	97.8%	
150	3%Ti	0.037%PFOFCS 0.1%CD1012 0.21%Irg184 1.35%ECHMCHC 0.6%HEMA 0.246%Ti 1%SR399	2%SR399 0.32%Ti 0.06%Irg184 (UV 60 s)	94.4%	
151	1.3%HEMA 0.96%SR640 3.576%Ti-Bu	0.05%BDKK 0.57%SR399 0.43%HEMA 5.66%Si	0.164%HEMA 0.05%PFOTCS 97.86%IPA 1.93%MP	98.5%	

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
152	3.5%Ti-Bu	0.087%BDKK 0.095%Ti-Bu 1%SR399 2.9%Si	0.035%BDKK 0.4%SR399 0.005%PFOTCS 0.005%FC430 0.005%BYK300	97.0%	
153	3 5%Ti-Bu	0.043%BDKK 0.047%Ti-Bu 0.5%SR399 1.45%Si	0.174%BDKK 0.173%Ti-Bu 2%SR399	94.0%	BLUE
154	5%Ti-Bu/5% Ti-Bu	0.033%BDKK 0.095%Ti-Bu 0.375%SR399 2.5%Si	0.026%BDKK 0.3%SR399 0.0037%PFOTCS 0.0037%FC430 0.0037%BYK300	97.2%	
155	1.15%Ti-Bu 0.84%Ti 0.55%SR399 0.068%Irg184 18 5ppmBYK300 18.5ppmPFOMA	1.15%Ti-Bu 0.84%Ti 0.55%SR399 0.068%Irg184 18.5ppmBYK300 18.5ppmPFOMA	1.5%SR399 0.1%Irg184 50ppmBYK300 50ppmPFOMA	95.7%	YELLOW

In Table 5, Layer 1 refers to the first antireflective coating layer, Layer 2 refers to an intermediate silicon layer, and Layer 3 refers to the second antireflective coating layer. Solutions of each of the components were prepared and used to form the antireflective coatings. For all of the compositions listed in Table 5, the remainder of the composition is made up of 1-methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The plastic eyeglass lens was coated using different coating compositions. The "Layer 1" composition was added to a surface of the eyeglass lens and the eyeglass lens was rotated on a lens spin-coating apparatus. After the Layer 1 composition was spread onto the eyeglass lens surface the solvent was allowed to substantially evaporate and the remaining composition was subjected to ultraviolet light from the germicidal lamp from the previously described coating unit for about 60 seconds, unless otherwise noted. Layer 2 (the silicon layer) was added to the eyeglass lens after the Layer 1 composition was cured. Curing time of the second layer is 60 seconds, unless otherwise noted. The Layer 2 composition was spread onto the eyeglass lens surface and the eyeglass lens was spun until the solvent was substantially evaporated. The Layer 3 composition was added to the

eyeglass lens after the Layer 2 composition was dried. The eyeglass lens was spun on a lens spin-coating apparatus until the solvent was substantially evaporated. Layer 3 was then cured by the application of ultraviolet light from the germicidal lamp from the previously described coating unit. Curing time for the third layer is 60 seconds, unless otherwise noted. From one to four additional layers were added to the top of the antireflective stack. The % transmittance refers to the amount of light transmitted through the lens after the final layer was cured. The transmittance was measured as described above.

TABLE 5

Ex. #	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Visible Light Transmittance %	Color
156	1 5%Ti 454ppmAA 300ppmAS 92 8%MP 5 6%IPA (UV 40 s)	1 5%Si 98.5%IPA (UV 40 s)	0 257%Ti 0 257%GPTMS 2 85%HC-8 0 5%Al 0 26%TMSPMA (UV 120 s)	HR200				96 0%	BROWN GOLD
157	1 5%Ti 76ppmAA 28 4%MP 70 1%IPA (UV 60 s)	1 5%Si 98 5%IPA (UV 40 s)	0 46%Ti 0 75%GPTMS 0 83%TMSPMA 3 4%HC-8 0 9%Al (UV 120 s)	HR200				94 4%	
158	3%Ti (UV 70 s)	1 5%Si	0 055%Irg184 0 22%Ti 1%SR399 0 0125%PFOMA (UV 70 s)	0 055%Irg184 0 22%Ti 1%SR399 0 0125%PFOMA (UV 60 s)				97 4%	
159	3%Ti (UV 60 s)	1 5%Si (UV 20 s)	0 025%Irg184 0 14%Ti 0 96%SR399 (UV 20 s)	1 5%Si	0 025%Irg184 0 14%Ti 0 96%SR399 (UV 60 s)			94 5%	YELLOW
160	3%Ti (UV 60 s)	1 5%Si	1 5%Si	0 08%Irg184 0.32%Ti 1 44%SR399 0.005%PFOTCS (UV 60 s)				97 4	RED
161	3%Ti (UV 60 s)	1 5%Si	1 5%Si (UV 60 s)	0 08%Irg184 0 32%Ti 1 44%SR399 0 005%PFOTCS (UV 60 s)				97 3	
162	3%Ti (UV 60 s)	1 5%Si	1 5%Si (UV 60 s)	0 11%Irg184 0 44%Ti 2%SR399 0 005%PFOTCS (UV 60 s)				93	
163	3%Ti	1 5%Si	1 5%Si	0 055%Irg184 0 22%Ti 1%SR399 0.0125%PFOTCS				95 3%	
164	3%Ti	1 5%Si	1 5%Si	0 055%Irg184 0 22%Ti 1%SR399 0 0125%PFOTCS	0 055%Irg184 0 22%Ti 1%SR399 0 0125%PFOTCS			94.6%	
165	3%Ti 0 53%SR640 70ppmFC430 (UV 60 s)	2.4%Si 0 97%SR640 70ppmFC430	2.4%Si 0.97%SR640 70ppmFC430	0 08%Irg184 0.32%Ti 1.44%SR399 0 005%PFOTCS				97.6%	
166	3%Ti	5%Si	0.33%SR399 0 07%Ti 0.018%Irg184 0.07%PFOMA	0.527%SR399 0 23%Ti 0 029%Irg184 0.066%PFOMA				97 3%	
167	3 85%Ti-Bu 0 25%SR399 0 017%Irg184 8ppmBYK300 8ppmPFOMA	1%SR399 2 4%Si	1%SR399 2.4%Si	1.15%Ti-Bu 0 84%Ti 0 55%SR399 0 068%Irg184 18 5ppmBYK300 18 5ppmPFOMA (UV 60 s)	1 739%SR399 0 12%Irg184 60ppmBYK300 60ppmPFOMA			96.7%	

In Table 6, Layer 1 refers to the first antireflective coating layer, Layer 2 refers to an intermediate silicon layer, and Layer 3 refers to the second antireflective coating layer. Solutions of each of the components were prepared and used to form the antireflective coatings. For all of the compositions listed in Table 6, the remainder of the composition

is made up of 1-methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The plastic eyeglass lens was coated using different coating compositions. The "Layer 1" composition was added to a surface of the eyeglass lens and the eyeglass lens was rotated on a lens spin-coating apparatus. The first coating layer was formed by a two step procedure. In the first step, a solution of Ti was added to the plastic lens and allowed to dry. In the second step, an additional solution of Ti was added to the plastic lens and allowed to dry. The % of Ti used for the first and second steps are respectively listed in the "Layer 1" column. The Layer 1 composition was allowed to substantially evaporate and the remaining composition was subjected to ultraviolet light from the germicidal lamp from the previously described coating unit for about 60 seconds, unless otherwise noted. Layer 2 (the silicon layer) was added to the eyeglass lens after the Layer 1 composition was cured. The Layer 2 composition was spread onto the eyeglass lens surface and the eyeglass lens was spun until the solvent was substantially evaporated. The Layer 3 composition was added to the eyeglass lens after the Layer 2 composition was dried. The eyeglass lens was spun on a lens spin-coating apparatus until the solvent was substantially evaporated. Layer 3 was then cured by the application of ultraviolet light from the germicidal lamp from the previously described coating unit. Curing time was 60 seconds, unless otherwise noted. From one to four additional layers were added to the top of the antireflective stack. The % transmittance refers to the amount of light transmitted through the lens after the final layer was cured. The transmittance was measured as described above.

TABLE 6

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
168	1.5%Ti/3%Ti (UV 40s/40s)	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399 (UV 60 s)	97.6%	BLUE
169	3%Ti/1.5%Ti (UV 40s/40s)	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399 (UV 60 s)	98.3%	PURPLE
170	5%Ti/3%Ti (UV 40s/40s)	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399 (UV 90 s)	92.2%	
171	3%Ti/5%Ti (UV 40s/40s)	3%Si	0 08%Irg184 0.32%Ti 1.45%SR399 (UV 90 s)	94.1%	
172	1.5%Ti/1.5%Ti (UV 60s/60s)	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399	97.6%	
173	3%Ti/3%Ti (UV 60s/60s)	3%Si (UV 30 s)	0.08%Irg184 0.32%Ti 1 45%SR399	97.6%	

In Table 7, Layer 1 refers to the first antireflective coating layer, Layer 2 refers to an intermediate silicon layer, and Layer 3 refers to the second antireflective coating layer. Solutions of each of the components were prepared and used to form the antireflective coatings. For all of the compositions listed in Table 7, the remainder of the composition is made up of 1-methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The application of the compositions to the plastic lens, and the measurement of the transmittance was performed in substantially the same manner as recited above for Table 1. Curing time was 60 seconds, unless otherwise noted.

TABLE 7

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
174	3%Ti	6%Si	0.8%Ti 0.8%GPTMS 0.8%TMSPMA	96.0%	
175	5.2%Ti 0 97%HC8558	5%Si	0.75%Ti 0.75%HC8558	96.6%	
176	3.75%Ti 0.019%AA 71%MP 25.25%IPA	3%Si 97%IPA	0.257%Ti 0.257%GPTMS 2.85%HC-8 0.5%Al	98.3%	RED
177	3.75%Ti 0.019%AA 71%MP 25.25%IPA	1.5%Si 98.5%IPA	0.257%Ti 0.257%GPTMS 2.85%HC-8 0.5%Al	95.6%	RED
178	7.5%Ti 0.038AA 45 3%MP 47.2%IPA	1.5%Si 98.5%IPA	0.257%Ti 0.257%GPTMS 2.85%HC-8 0.5%Al	96.0%	RED
179	3%Ti	5%Si	0.16%Ti 1%SR399 50ppmPFOFCS	98.1%	
180	3%Ti	6.94%Nalco Si	0.16%Ti 1%SR399 50ppmPFOFCS	95.7%	
181	3%Ti	6.94%Nalco Si	0.317%Ti 2%SR399 0.08%Irg184 0.06%PFOFCS	93.0%	
182	3%Ti	3%Si	0.11%Irg184 0.44%Ti 2%SR399	93.0%	BLUE
183	3%Ti	3%Si	0.05%Irg184 0.02%Ti 0.9%SR399	94.3%	GOLD
184	3%Ti	4%Si	0.05%Irg184 0.2%Ti 0.9%SR399	96.4%	
185	3%Ti	5%Si	0.05%Irg184 0.2%Ti 0.9%SR399	97.9%	
186	3%Ti	4%Si	0.079%Irg184 0.322%Ti 1.45%SR399	97.0%	
187	3%Ti	4%Si	0.079%Irg184 0.322%Ti 1.45%SR399	96.8%	
188	3%Ti	3%Si	0.079%Irg184 0.322%Ti 1.45%SR399	97.3%	
189	3%Ti	3%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOA	97.7%	

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
190	3%Ti	3%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.047%PFOMA	97.6%	
191	3%Ti	3%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOTCS	97.8%	
192	3%Ti	5%Si	0.08%Irg184 0.32%Ti 1 44%SR399 0.005%PFOTCS	95.7%	
193	1.5%Ti	5%Si	0.08%Irg184 0.32%Ti 1.45%SR399	94.6%	
194	1.5%Ti	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399	95.1%	
195	2%Ti	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399	95.6%	
196	2%Ti 0.03%BYK300	3%Si	0.08%Irg184 0.32%Ti 1.45%SR399	96.0%	
197	3%Ti	1.5%Si	0.11%Irg184 0.44%Ti 2%SR399 0.005%PFOMA	97.2%	
198	3%Ti	1.5%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOMA	95.0%	
199	3%Ti	1.5%Si	0.11%Irg184 0.44%Ti 2%SR399 0.005%PFOMA	96.7%	
200	3%Ti 0.53%SR640	3%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOTCS	97.5%	
201	3%Ti	3%Si	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOTCS	97.1%	
202	3%Ti	3%Si 0.5%SR640	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOTCS	97.8%	
203	3%Ti 0.53%SR640 70ppmFC430	3%Si 0.53%SR640 70ppmFC430	0.08%Irg184 0.32%Ti 1.44%SR399 0.005%PFOTCS	97.8%	
204	3%Ti	5%Si	1.44%SR399 0.32%Ti 0.08%Irg184 0.005%PFOTCS	97.4%	
205	3.85%Ti-Bu 0.25%SR399 0.017%Irg184 8ppmBYK300 8ppmPFOMA	5%Si	1.56%Ti-Bu 0.5%SR399 0.033%Irg184 16ppmBYK300 16ppmPFOMA	95.8%	YELLOW

Table 8 refers to a series of experiments using an in-mold curing process. In the in-mold process the layers are built in the opposite manner than they are built upon the plastic lens. Layer 1, thus, refers to the second antireflective coating layer, Layer 2 refers to the first antireflective coating layer, and Layer 3 refers to an adhesion layer. Solutions of each of the components were prepared and used to form the antireflective coatings. For all of the compositions listed in Table 8, the remainder of the composition is made up of 1-methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

A casting face of a mold was coated using the different coating compositions. The "Layer 1" composition was added to a surface of the mold and the mold was rotated on a lens spin-coating apparatus. The Layer 1 composition was allowed to substantially evaporate and the remaining composition was subjected to ultraviolet light from the germicidal lamp from the previously described coating unit for about 60 seconds, unless otherwise noted. Layer 2 was added to the eyeglass lens after the Layer 1 composition was cured. The Layer 2 composition was spread onto the eyeglass lens surface and the eyeglass lens was spun until the solvent was substantially evaporated. Layer 2 was then cured by the application of ultraviolet light from the germicidal lamp from the previously described coating unit. Curing time was 60 seconds, unless otherwise noted. Layer 3 was then added to the antireflective stack. Layer 3 was added to the mold, spun dried and cured. Curing time was 60 seconds, unless otherwise noted.

A pair of coated molds was then used to in a mold assembly to form a plastic lens. After the lens was formed, the lens was removed from mold assembly and the % transmittance of the plastic lens measured. The transmittance was measured as described above.

TABLE 8

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
206	1%SR399 0.059%Irg184 0.007%PFOMA			92.5%	
207	1%SR399 0.059%Irg184 0.007%PFOMA 0.0062%Q4DC			92.5%	
208	1%SR399 0.059%Irg184 0.007%PFOMA 0.0062%Q4DC	1.44%SR399 0.08%Irg184 0.32%Ti 0.005%PFOTCS	3%Ti	97.0%	GOLD
209	2.58%SR399 0.147%Irg184 0.32%Ti-Bu (UV 60 s)	4%Ti-Bu 1.2%HEMA 14%IPA (UV 60 s)	2.58%SR399 0.147%Irg184 0.32%Ti-Bu (UV 60 s)	94.5%	
210	2.2%SR399 0.126%Irg184 0.003%PFOMA	2.2%SR399 0.126%Irg184 0.003%PFOMA	2.2%SR399 0.126%Irg184 0.003%PFOMA	97 7%	BLUISH RED
211	2.2%SR399 0.126%Irg184 0.0031%PFOMA	4%Ti-Bu 1.2%HEMA 14%IPA		97.7%	
212	2.2%SR399 0.14%D1173	4%Ti-Bu 1.2%HEMA 14%IPA		97.1%	
213	2.2%SR399 0.14%D1173 (UV 70 s)	2.022%Ti-Bu 2.026%HEMA (UV 70 s)	1%Si 2.2%SR399 0.165%Ti-Bu 0.14%D1173 (UV 70 s)	>95.5	
214	2.06%SR399 0.136%D1173 0.95%HEMA (UV 90 s)	3.62%Ti-Bu 1.5%HEMA (UV 90 s)	2.06%SR399 0.136%D1173 0.95%HEMA (UV 90 s)	97.0%	RED GOLD
215	2%SR399 0.145%D1173 (UV 90 s)	3.62%Ti-Bu 1.5%HEMA (UV 90 s)	2.12%SR399 0.14%D1173 0.5%HEMA (UV 90 s)	97.0%	
216	2.2%SR399 0.117%BDK	3.6%Ti-Bu 1.5%HEMA	2.2%SR399 0.117%BDK (UV 90 s)	94.7%	
217	2.66%SR399 0.114%BDK	3.6%Ti-Bu 1.5%HEMA	2.66%SR399 0.114%BDK (UV 90 s)	95.0%	
218	2.886%SR399 0.124%BDK	3.6%Ti-Bu 1.5%HEMA	2.886%SR399 0.124%BDK	94.5%	
219	2.2%SR399 0.19%BDK (UV 60 s)	3.46%Ti-Bu (UV 60 s)	2.2%SR399 0.19%BDK (UV 60 s)	97.7%	
220	2.2%SR399 0.19%BDK (UV 60 s)	3.7%Ti-Bu 0.005%PFOMA 0.003%BDK (UV 60 s)	2.2%SR399 0.19%BDK	97.6%	
221	2.2%SR399 0.19%BDK	3.7%Ti-Bu 0.0247%BDK 0.028%PFOTCS 0.091%HEMA	2.2%SR399 0.19%BDK	98.0%	

Ex. #	Layer 1	Layer 2	Layer 3	Visible Light Transmittance %	Color
222	2.2%SR399 0.19%BDK (UV 60 s)	3.7%Ti-Bu 0.0123%BDK 0.014%PFOTCS 0.045%HEMA	2.2%SR399 0.19%BDK	98.2%	
223	0.028%BDK 0.32%SR399 0.24%HEMA 3.2%Si	1.3%HEMA 0.96%SR640 3.576%Ti-Bu	0.19%BDK 2.2%SR399 0.01%HEMA 0.03%PFOTCS 5.9%IPA 91.7%MP	95.2%	
224	1.5%SR399 0.1%Irg184 0.005%BYK300 0.005%PFOMA	3.849%Ti 0.25%SR399 0.0016%Irg184 8ppmBYK300 8ppmPFOMA	1.04%Ti 0.5%SR399 0.033%Irg184 16ppmBYK300 16ppmPFOMA	94.7%	

In Table 9, multiple coating layers are formed on the casting surface of the molds prior to use. For all of the compositions listed in Table 9, the remainder of the composition is made up of 1-methoxy-2-propanol. For example, a listing of 5% Ti, should be understood to mean 5% by weight of Ti and 95% by weight of 1-methoxy-2-propanol.

The application of the compositions to the lenses, and the measurement of the transmittance was performed in substantially the same manner as recited above for Table 8. Curing times were 60 seconds, unless otherwise noted.

TABLE 9

Ex. #	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Visible Light Transmittance %	Color
225	0 5%SR399 0 02%Irg184 0 02%PFOMA	1 44%SR399 0 32%Ti 0 08%Irg184 0 005%PFOTCS	3%Ti	HC-8				96 7%	
226	0 05%BDKK 0 57%SR399 0 43%HEMA 5 66%Si	1 3%HEMA 0 96%SR640 3 576%Ti-Bu	0 19%BDKK 2 2%SR399 0 01%HEMA 0 03%PFOTCS 5 9%IPA 91 7%MP	0 164%HEMA 0 05%PFOTCS 97 86%IPA 1 93%MP				94.7%	
227	0 01%FC725 40%IPA 0 015%FC171 50%AC	0 0134%Irg184 0 033%D1173 0 527%SR399 0 178%SR423 0 088%SR9003 0 008%CD540 0 06%ppmTPB (UV 60 s)	0 6%SR399 0 03%Irg184 0 3%Ti 3 3%Si	0 9%SR399 0.04%Irg184 0 19%Ti (UV 60 s)	4%Ti	0 01%FC725 40%IPA 0 015%FC171 50%AC		97 7%	
228	0 01%FC725 0 015%FC171 50%IPA 50%AC	0 0134%Irg184 0 033%D1173 0 527%SR399 0 178%SR423 0 088%SR9003 0 008%CD540 0 06ppmTPB	1 4%SR399 0 1%Irg184 0 3%Ti	4%Ti 0 04%TX-100	0 6%SR399 0 03%Irg184 0 3%Ti 3 3%Si	0 0134%Irg184 0.033%D1173 0 527%SR399 0 178%SR423 0 088%SR9003 0 008%CD540 0 06ppmTPB		97 5%	
229	0 01%FC725 50%IPA 0 015%FC171 50%AC	1%SR399 0 5%SR368 0 01%Irg184 0 05%TPB	0 9%SR399 0 042%Irg184 0 19%Ti	4%Ti 0.04%TX-100	0 9%SR399 0 042%Irg184 0 19%Ti	1%SR399 0.5%SR368 0 01%Irg184 0 05%TPB		98 0%	
230	1 5%SR399 0 1%Irg184 0 005%BYK300 0 005%PFOMA	1 04%Ti 0 5%SR399 0 033%Irg184 16ppmBYK300 16ppmPFOMA	3 849%Ti 0.25%SR399 0 0016%Irg184 8ppmBYK300 8ppmPFOMA	1 5%SR399 0 1%Irg184 0 005%BYK300 0 005%PFOMA				97 5%	
231	1 5%SR399 0 1%Irg184 0.005%BYK300 0 005%PFOMA	2 5%Si / 2 5% Si	1 04%Ti 0 5%SR399 0 033%Irg184 16ppmBYK300 16ppmPFOMA	1 04%Ti 0 5%SR399 0 033%Irg184 16ppmBYK300 16ppmPFOMA	3 849%Ti 0 25%SR399 0 0016%Irg184 8ppmBYK300 8ppmPFOMA	1 04%Ti 0 5%SR399 0.033%Irg184 16ppmBYK300 16ppmPFOMA		95 5%	
232	1 5%SR399 0 1%Irg184 0 005%BYK300 0 005%PFOMA	1 04%Ti 0 5%SR399 0 033%Irg184 16ppmBYK300 16ppmPFOMA	3 849%Ti 0 25%SR399 0 0016%Irg184 8ppmBYK300 8ppmPFOMA	0.3%Ti 1 4%SR399 0.06%Irg184	2 5%Si	1 04%Ti 0 5%SR399 0 033%Irg184 16ppmBYK300 16ppmPFOMA		97 0%	

Further modifications and alternative embodiments of various aspects of the invention will be apparent to those skilled in the art in view of this description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the general manner of carrying out the invention. It is to be understood that the forms of the invention shown and described herein are to be taken as the presently preferred embodiments. Elements and materials may be substituted for those illustrated and described herein, parts and processes may be reversed, and certain features of the invention may be utilized independently, all as would be apparent to one skilled in the art after having the benefit of this description of the invention. Changes may be made in the elements described herein without departing from the spirit and scope of the invention as described in the following claims.